



Department of Justice
Canada

Ministère de la Justice
Canada

IMPAIRED DRIVING

Report No. 4

**ALCOHOL AND ROAD ACCIDENTS
IN CANADA:**

**ISSUES RELATED TO FUTURE
STRATEGIES AND PRIORITIES**

**POLICY, PROGRAMS
AND RESEARCH BRANCH**

**RESEARCH AND
STATISTICS SECTION**

Canada

ALCOHOL AND ROAD ACCIDENTS IN CANADA:

ISSUES RELATED TO
FUTURE STRATEGIES AND PRIORITIES

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January 1985

This report was prepared under contract to the Department of Justice, Canada. Points of view or opinions stated in this report are those of the author and do not necessarily represent the views or policies of the Department of Justice.

To all those who pioneered work in this area
and
to all those who cultivate the field.

AUTHOR'S NOTE

This report is an integration, synthesis, and update of two other reports:

- o Warren, R.A., and Donelson, A.C. 1982. Alcohol and Traffic Safety: Strategies and Priorities for the Future. Final Report. Ottawa, Ontario: The Traffic Injury Research Foundation of Canada.
- o Donelson, A.C. 1983. Alcohol and Road Accidents: Future Strategies and Priorities. Ottawa, Ontario: The Traffic Injury Research Foundation of Canada.

An initial draft of the report by Warren and Donelson (1982) served as a background paper for an international workshop dealing with the same topic. The Road and Motor Vehicle Traffic Safety Branch (now the Road Safety and Motor Vehicle Regulation Directorate) of Transport Canada sponsored the preparation of the report. The Alberta Alcoholism and Drug Abuse Commission (AADAC) sponsored the workshop, which the Foundation conducted from November 29 to December 2, 1981, in Lake Louise, Alberta. After the workshop, Reg Warren, by then a private consultant under contract to the Foundation, had primary responsibility for revising the initial draft. The Foundation submitted the completed report to Transport Canada in March 1982. During 1982, I prepared a report on the proceedings of the workshop. This effort, also sponsored by AADAC, resulted in the publication of a separate report, "Alcohol and Road Accidents: Future Strategies and Priorities", in May 1983.

The two reports' similar titles evidence (to borrow from biology) their "sympiotic evolution". The background paper provided a common base of knowledge to workshop participants. They, in turn, provided insightful comments and constructive criticism, thereby contributing to its revision. The proceedings of the workshop took up where the background report itself stopped, looking past the issues to a broad outline, or framework, for future action programs, evaluation, and research. The workshop report, therefore, complements the other.

Since the conduct of the workshop and the release of both reports, Canada witnessed a surge in public concern over the problem of "drunk driving". (The reports, however timely, had little to do with this phenomenon.) Spearheaded by Candy Lightner, founder of Mothers Against Drunk Drivers (MADD), and other victims who followed her example, citizen activist groups brought this social problem to near the top of political agenda in many jurisdictions across North America. They succeeded in spurring governments to act--for example, by passing new legislation and forming interagency task forces to plan and coordinate action programs. They motivated the corporate sector to launch mass media campaigns. They themselves filled the print and electronic media with their tragic stories. And not least among their many accomplishments--which include local, community-based programs--citizen activist groups have helped create an unprecedented degree of public awareness about a seemingly intransigent, persistent problem.

In Canada, at the Federal level, the Department of Justice, Canada, took a leading role in responding to demands by citizens' groups for action. The Department initiated a comprehensive review of present knowledge, planned short- and long-term initiatives, and, as one interim result, proposed changes to the Criminal Code relating to alcohol-impaired driving offences. In addition, the Department assembled an inter-departmental task force in an effort to establish a coordinated, cooperative approach to the problem.

Early in the process, staff of the Department of Justice, Canada, sought out those active in the field for information and advice on issues under review. The Foundation, with its long-standing program of research and development in the area of drinking and driving, contributed substantially to that effort. Its recently released reports also served well, providing convenient digests of pertinent data and informed judgments about future directions. As other agencies and organizations across Canada reexamined drinking-driving problems and, once again, considered alternative approaches to dealing with it, they too found the Foundation's reports useful resources.

In 1983, the Foundation proposed to carry out a project for the Department of Justice, Canada. The overall aim of the proposed project was to support, in part, the Department's larger effort in the area of drinking and driving. The Department accepted the proposal and funded its several, interrelated components. One task resulted in the present report. The effort involved (1) revising the report originally sponsored by Transport Canada; (2) integrating the general findings of the workshop sponsored by AADAC; (3) updating information to provide the most recent data available; and (4) incorporating new material reflecting developments in the field. As the one who had primary responsibility for accomplishing this task, I acknowledge the earlier contribution of my former colleague, Mr. Warren. His original treatment of societal responses to the alcohol-crash problem remains the basis of Part Two of this report. Of course, he is in no way accountable for the substantial revisions and editing of the previous report (Warren and Donelson 1982).

Other members of the project team deserve credit for their contributions. Gordon Haas and Peter Walsh tracked down recent data and prepared tables and figures updating the previous report. Mr. Walsh also took responsibility for ensuring the accuracy and completeness of references in the report's bibliography. Dan Mayhew provided welcome assistance in the final stages of report production. Jill Forrest and Wendy Wood transformed type-written copy into word-processed galleys. Claire Ryan, Administrative Assistant, supervised the production of this report. Herb Simpson, Executive Director of the Foundation, had overall responsibility for administrative aspects of the project. He also guided and supported the preparation of this report, from distant origins to now.

Finally, this report is a comprehensive overview of knowledge, issues, and future directions. The project sponsored by the Department of Justice, Canada, also produced several other reports concerning alcohol and road accidents.

- o Donelson, A.C., and Beirness, D.J. 1984. Legislative Issues Related to Drinking and Driving. Final Report. Ottawa, Ontario: The Traffic Injury Research Foundation of Canada.

This report examined the factual basis of possible changes to Section 236(1) of the Criminal Code of Canada. Two specific changes studied were: (1) lowering the current blood alcohol concentration (BAC) limit from 80 mg% to 50 mg%; and (2) creating a "two-tiered" section, with BACs over a limit higher than 80 mg%--for example 150 mg%--considered a more serious offence of alcohol-impaired driving, which would warrant increased penalties. Experimental and epidemiologic data relevant to these changes were summarized, and other issues--legal, social, practical, and ethical--were identified.

- o Beirness, D.J.; Haas, G.C.; Walsh, P.J.; and Donelson, A.C. 1984. Alcohol and Fatal Road Accidents in Canada: A Statistical Look at Its Magnitude and Persistence. Ottawa, Ontario: The Traffic Injury Research Foundation of Canada.

As its title suggests, this report presents extensive data on alcohol use by persons fatally injured in road accidents in Canada. Data from TIRF's Fatality Data Base were analyzed to identify (1) trends in the nature and extent of the problem and (2) differences among the seven provinces included in the study. Most remarkable among the findings was the consistency of year-to-year statistics from 1973 through 1982.

- o Donelson, A.C.; Beirness, D.J.; and Mayhew, D.R. 1984. Characteristics of Drinking Drivers. Ottawa, Ontario: The Traffic Injury Research Foundation of Canada.

This report summarizes present knowledge of the attributes and characteristics of different groups of drinking drivers: (1) those who drive with a positive blood alcohol concentration (BACs); (2) those who drive with a BAC exceeding legal limit or who become impaired at lower BACs; and (3) those who become involved in road accidents. The overall aim of the study was to compile such information and to identify issues concerning sentencing options for persons convicted of alcohol-related driving offences. A comprehensive approach to dealing more effectively with the problem of recidivism is outlined.

In addition to the present report, the interested reader will find these other reports useful as resources for policy planning, program development, as well as general information.

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ALCOHOL AND ROAD ACCIDENTS IN CANADA
A REPORT ON ISSUES RELATED TO FUTURE STRATEGIES AND PRIORITIES

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1.0 INTRODUCTION

To reexamine, in the light of present knowledge, the problems of alcohol and road accidents and alcohol-impaired driving is to acknowledge their persistence, their resistance to efforts launched to reduce them. The remarkable consistency of year-to-year statistics on drinking and driving compels us to question the effectiveness of our overall social response. To explore once again alternative directions for future action reflects our collective unwillingness to tolerate the widespread damage to people and property resulting from these problems.

A key issue, therefore, confronts us:

- o Are new initiatives possible for reducing road accidents and losses due to alcohol-impaired driving, or must past actions to deal with the problem --based on traditional and largely ineffective approaches--be continued, with efforts perhaps increased ten-fold?

The present report addresses this issue as well as many other unanswered questions about drinking and driving. In discussing future directions for policy, programs, research, and evaluation, it also represents an initial step in the process of evolving new strategies and reordering priorities for the 1980's and beyond.

1.1 Background

In 1872, England enacted the first of its series of laws against "drunk driving" (Smith 1963):

Every person...who is drunk while in charge on any highway or other public place of any carriage, horse, cattle, or steam engine may be apprehended, and shall be liable to a penalty not exceeding forty shillings, or in the discretion of the court to imprisonment...for any term not exceeding one month.

In 1904, The Quarterly Journal of Inebriety ran its oft-cited editorial:

We have received a communication containing the history of twenty-five fatal accidents occurring to automobile wagons....A careful inquiry showed that in nineteen of these accidents the drivers had used spirits within an hour or more of the disaster....The author of this communication shows very clearly that the management of automobile wagons is far more dangerous for men who drink than the driving of locomotives on steel rails. Inebriates and moderate drinkers are the most incapable of all persons to drive power wagons....With the increased popularity of these wagons, accidents of this kind will rapidly multiply, and we invite our readers to make notes of disasters of this kind. (pp. 308-309)

Unfortunately, as we well know, its dire prediction proved all too true.

Thus, over 100 years ago, against a complex background of rapid societal change, the alcohol-crash problem began to emerge as a distinct, though ill-defined, social concern. Later decades sustained two trends that greatly increased this concern:

- o the proliferation of private automobiles with ever increasing power and potential speed; and
- o the end of Prohibition, with gradual relaxing of laws and regulations on the manufacture, sale, and distribution of alcoholic beverages.

As people in industrialized societies drove more, reaping the benefits of greater mobility, the costs of road accidents grew. The multi-disciplinary field of road safety took form as governments responded with a spate of new laws and regulations aimed at road builders, vehicle manufacturers, and road users alike. As people consumed more beer, wine, and spirits, health problems attributed to alcohol increased. Alcohol and health developed as a specialized area, also involving many different disciplines and agencies. The complex mixture of alcohol and motor vehicle use, along with its predicted "side-effect"--alcohol-related road accidents--gave rise in time to an even more complicated array of concerned agencies and organizations, from legal, safety, and health sectors.

Public appreciation of the extent of the problem and its complexity came slowly. Preventive measures that relied heavily on the criminal justice system were nonetheless developed and implemented, even though knowledge about the problem was fragmentary. "The problem was big" and "something had to be done about it". However, without careful study to define the problem and to measure accident risk associated with alcohol-impaired driving, no one knew how large the problem was, nor how much difference laws, mass media campaigns, and other measures made.

By 1935, anecdotal accounts of the problem had given way to scientific studies of alcohol and road accidents. At present, after many decades of effort, we know far more than when efforts to reduce the problem were first conceived and launched. Surprisingly, perhaps, the state of knowledge, however advanced, remains limited and, for many purposes, inadequate. We can only estimate roughly the extent of the problem and its cost to society. For example, the question "How many people are killed or injured by drunk drivers each year?" remains unanswered. We know how alcohol affects human skills and abilities; we know little about how alcohol impairs the ability to drive and how alcohol influences the willingness to drive safely. We do know that efforts to deter alcohol-impaired persons from driving have made little difference. The admonition "If you drink, don't drive; if you drive, don't drink." has been heard, and not heeded, by very large numbers of people. Information about drinking and driving, although widely held, appears impotent in changing behaviour--unless married to intensive police enforcement of impaired-driving laws, which many disregard, some often. In recent years, persons who study and deal with this problem have expressed a growing sense of frustration over its magnitude and its persistence. They have begun to acknowledge that, despite many, diverse programs, few have had any measurable effect; that inroads have been difficult at best; that successes have proved marginal, costly, and temporary.

Every few years for several decades, experts have discussed the alcohol-crash problem and reviewed progress to date. Conferences, task forces, and commissions have issued recommendations for better programs

and more research. For the most part, governments have refined past programs, using approaches already found lacking in terms of sought-for results: a sustained decrease in alcohol-involved traffic deaths, injuries, and other losses. This strategy has been described as "keeping the lid on the problem". Such policy suggests a pronounced absence of direction and evidences a strong need to reconsider how best to proceed in coming decades.

Since 1980, we have witnessed a remarkable surge in public awareness and a striking intensification of programmatic efforts. Although cycles of concern and complacency have always characterized the decades of organized social response to drinking-driving problems (Douglass 1982), what distinguishes the present wave of concern from others in the past is the emergence of citizens' groups (e.g., Lightner 1981). These grassroots organizations, formed by persons who have suffered direct loss from traffic accidents caused by alcohol-impaired drivers, have taken a leadership role in the field. They ask, as experts have--but with the force of bitter, angry emotion--WHY? They also demand action--NOW! Through the media and directly to policy makers, these groups advocate strong measures to deal with a problem they have personally experienced. Their conviction and their commitment have done far more to motivate renewed efforts than have hundreds of studies showing that the problem is big and persistent. Perhaps most importantly, grassroots groups have initiated local, community-based efforts to reduce drinking-driving problems. The movement as a whole represents a "bottom-up" approach to these problems, in contrast to traditional "top-down" intervention (Donelson 1984a). Many experts have remained skeptical about the longevity of citizens' groups and their ability to contribute over the longer term. This, despite their already profound impact at Federal, state or provincial, and local levels in North America. Although only time will tell, John Naisbitt's observations in his book Megatrends support the contention that citizens' groups and other community-based agencies and organizations will play a key role in the coming decades. In the context of the shift from centralization to decentralized structures, Naisbitt (1984) wrote:

Localized political power is not delegated from the federal level to the state, municipal, or neighborhood levels. Rather, it stems from the initiatives taken by the state or neighborhood in the absence of an effective top-down solution....Power that is bestowed from the top down can be withdrawn if the donor's priorities change. Successful initiatives hammered out at the local level have staying power. Local solutions are resistant to top-down intervention and become models for others still grappling with the problems....

The failure of centralized, top-down solutions has been accompanied by a huge upsurge in grassroots political activity everywhere in the United States. Some 20 million Americans are now organized around issues of local concern. About 25 percent of the population of any neighborhood in the country say they are members of a neighborhood group. Neighborhood groups are becoming powerful and demanding greater participation in decision making. (p. 121, emphasis added)

Naisbitt dealt primarily with the United States and, surprisingly, failed to mention among his other examples grassroots political activity and other initiatives related to drinking and driving. Nonetheless, we believe that his discussion has relevance, and that the trend towards greater reliance on local, community-based programs will continue. If so, then implications for policy planning and implementation at Federal and Provincial levels in Canada are great (see Traffic Injury Research Foundation of Canada 1984; Donelson 1983b).

In summary, we have a century's worth of experience with the problem of alcohol and road accidents. It is said that experience is a hard teacher, one that tests first and gives the lesson later. What lessons have we learned? Someone has also said that history does not repeat itself, that only people do. To avoid "reinventing the wheel", where do we go from here? How do we make a difference? These questions might seem, at first reading, those of an ivory-tower academic, curious and uninvolved. They are not. Victims of road accidents caused by drunk drivers now ask them, too, with far less patience.

1.2 Purpose of Report

In the midst of resurgent concern about drinking and driving, and during a period of revived action programs, why yet another report "talking about" the problem?

The Author's Note prefacing this report outlines its history, perhaps giving "surface reasons" for its revision and publication. A deeper rationale has to do with the issue expressed as a question at the start of this section:

- o Are new initiatives possible for reducing road accidents and losses due to alcohol-impaired driving, or must past actions to deal with the problem--based on traditional and largely ineffective approaches--be continued, with efforts perhaps increased ten-fold?

First and foremost, the initial draft of this report was prepared to assist others in addressing this question. Simply "keeping the lid on the problem" seemed to us like a cop-out, an abrogation of responsibility to seek out actively, and to implement vigorously, truly effective strategies, plans, and programs to reduce drinking-driving problems. Our review of what is known led to what is not known, to questions that go beyond available statistics and basic information about the problem. We had nicknamed the report "the issues paper" long before it had its first reader. Issues--some decades old--remain, even now, its main focus and raison d'etre. By dealing with issues, the alcohol-crash problem appears as it really is: complex, complicated, embedded in our daily, social activities. Because issues are barriers to dealing with the problem effectively, we think that this report has a special role to play in choosing future directions for taking action.

A second reason for this report also relates to the complexity of drinking-driving problems. As a direct result of the workshop for which the "issues paper" served as a resource, we realized that answers to questions posed and resolutions of current issues do not mean "simple

solutions". Critical steps to recognizing that "quick fixes" and "magic bullets" do not exist in the practical, work-a-day world are (1) gaining a deeper appreciation of the complexity of the problems and (2) developing a better understanding of the societal context in which they arise. The earlier version of this report assisted many to that end. Because the alcohol-crash problem does persist, and because many people hitherto unfamiliar with the problem have declared "war against drunk drivers", we at the Foundation believe that this report retains its value as an informational resource.

Thirdly, since the release of our reports prepared in 1981 and 1982, developments in the field have accelerated. Pertinent data from more recent years have become available, and the need for a comprehensive source of up-to-date, Canadian information has grown. The existing reports provided a convenient starting point for satisfying that need. In preparing this report, my colleagues and I took the opportunity (1) to update statistics contained in the "issues paper" (Warren and Donelson 1982); (2) to integrate findings from the workshop (Donelson 1983c); and (3) to add material outlining recent developments in the field, particularly a new, emerging perspective that points to community-based initiatives as a fresh approach to an old problem.

1.3 Scope of Report

This report has three parts and nine sections.

Part One, Defining the Problem of Alcohol and Road Accidents, describes the societal context in which the problem occurs and summarizes present knowledge about the magnitude and characteristics of drinking-driving problems.

Section 2.0, Context and Perspectives, discusses the scope and complexity of the problem, emphasizing the scale of phenomena associated with alcoholic beverage consumption and road transportation in Canada.

Section 3.0, The Magnitude and Characteristics of the Problem, presents up-to-date information with the main focus on the Canadian experience. This section reviews experimental and epidemiologic studies, identifying informational gaps and key issues in the field.

Part Two, A Review of Societal Responses to the Alcohol-crash Problem, deals primarily with issues surrounding past and on-going efforts to reduce the magnitude of alcohol-crash losses. As such, it does not catalogue separate countermeasure programs and report the effects, or lack thereof, of each. Rather, the "social response as a whole" is examined in light of the persistence of drinking-driving problems. Identified are issues that, if left unresolved, will continue to hinder attempts to deal with these problems effectively.

Section 5.0, The Alcohol Safety Community in Relation to the Problem, discusses a long-standing issue familiar to many active in the field--the polarized, often difficult relationship between those who would study the problem (Research Community) and those who would deal with it (Countermeasures Community). The dilemma of decision-makers, faced with conflicting views and differing opinions emanating from these and other "communities", is analyzed.

Section 6.0, Effectiveness of the Effort as a Whole: Alternative Perspectives, deals with issues arising from the lack of cooperation and integration among the various communities. In particular, conflicting opinions about progress in dealing with drinking-driving problems are explored. The central issue then becomes how to improve the effectiveness of the overall societal response to the problem.

Section 7.0, Existing Countermeasures Revisited, examines the theory and implications of countermeasure approaches. It analyzes and discusses the relationship between assumptions about the nature of the problem and programmatic initiatives to intervene in the process leading to alcohol-related road accidents. A central issue is the lack of an adequate

empirical basis for understanding how programs should work and for measuring their efficiency and effectiveness.

Section 8.0, Evaluation: The Elusive Missing Link, focuses on a general issue that has plagued the "effort as a whole" for decades. Evaluation represents a critical component whose function and role--if properly understood, accepted, and integrated into a strategic model--can support the advancement of knowledge and the refinement of action programs, in the process of taking action on the problem.

Part Three, Future Strategies and Priorities, consists of one section (9.0) with the same title. Its purpose is to summarize lessons from past experience and to discuss options for future action. This part of the report emphasizes preconditions and requirements for strategies, plans, and programs, including the need for a broader perspective of the problem. Steps toward developing and implementing longer range, comprehensive, strategic approaches are identified. The critical need for research--combined and integrated with action and evaluation components--is outlined. The concept of community-based initiatives as a "bottom-up", grassroots approach to local drinking-driving problems is presented.

PART ONE

DEFINING THE PROBLEM OF ALCOHOL AND ROAD ACCIDENTS

2.0 CONTEXT AND PERSPECTIVES

In treating alcohol and road accidents as a discrete problem, we first acknowledge the scale and complexity of phenomena associated with beverage alcohol and road transportation. It is one thing to note that alcohol-related crashes are one result of the "overlap" of two widespread activities (drinking and driving); it is quite another to appreciate the implications of that observation for developing and implementing effective responses to this problem. Accordingly, this introductory section briefly describes the societal context, or social environment, in which the alcohol-crash problem and its antecedent--alcohol-impaired driving--arise. Specific aims are:

- o to provide descriptive information on beverage alcohol consumption and motor vehicle use in Canada, with special emphasis on the extent of their adverse impact on public health and safety;
- o to define the scope of efforts relevant to dealing with drinking-driving problems; and, finally,
- o to raise an issue that relates generally to the alcohol-crash problem and the societal response to it, namely, whether this problem is one amenable to solution, given the present social milieu.

The treatment of these broad topics is, of necessity, skeletal. We hope that such information indicates the potential dimensions--and problems--of the area commonly termed "alcohol and traffic safety".

2.1 Beverage Alcohol in Canada

The history of alcoholic beverages and their use and role in society also lie beyond the scope of this report. Nevertheless, an observation providing a useful, historical perspective deserves note:

There is evidence that alcoholic beverages pre-date recorded history. In fact, there are few societies that have not known alcohol. It has been used for relaxation, social purposes, nutrition, ceremony and religion, and was one of the earliest medicines known to man. The widespread occurrence of alcoholic beverage use suggests

that the custom is strongly rooted in human behaviour, especially when one considers that it has survived in the face of competing customs and, at times, direct opposition. The discovery or invention of alcoholic beverages and their long use have been, no doubt, related to the special properties of alcohol as it affects humans and perhaps also to the beverages' ease of manufacture. (Smith 1973, p. 1)

Alcohol the drug also serves as a readily available intoxicant. Over the centuries its use for this purpose has been variously viewed by many as immoral, unhealthy, or illegal, and, by others, as pleasurable. Alcohol-related problems and disabilities have become the focus of international efforts aimed toward their understanding and prevention (Edwards et al. 1977; Moser 1974; World Health Organization 1981a). Yet, despite the broad array of preventive measures available to deal with alcohol-related problems, per capita consumption of beverage alcohol and associated problems have increased steadily over the past couple of decades (Moser 1980, pp. 39-93; Gerstein 1981).

2.1.1 Patterns of alcoholic beverage consumption in Canada. The amount and patterns of alcohol use in Canada have been estimated on the basis of beverage sales (spirits, wines, and beer) and household survey findings. Two recent Canadian reports have compiled statistics on alcohol use in Canada (Expert Committee on Alcohol Statistics 1981; Alcoholism and Drug Addiction Research Foundation [ARF] 1983.) Table 1 presents recent data on total sales and volume per capita; the percentage contribution of each beverage was 50% (beer), 13% (wine) and 37% (spirits) (ARF 1983, p. 46).

From data on total sales, apparent consumption is approximately 11.27 litres (2.48 gallons) of absolute alcohol a year per person 15 years or older. Figure 1 illustrates changes in provincial and Canadian per capita consumption from 1970-1978. Uncertainty over recent trends in alcohol use exists due to differences in recent estimates by governmental agencies and industry associations (Gilbert 1981c). Nevertheless, the trend of increasing consumption seen over recent decades appears to have moderated since the mid-1970's.

Table 1

PERCENTAGE ^a CONTRIBUTION OF EACH BEVERAGE ^a TO THE APPARENT TOTAL ALCOHOL CONSUMPTION,
CANADA AND PROVINCES, 1974-75 TO 1979-80

Province	Beer %						Wine %						Spirits %					
	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80
Nfld.	61	64	59	58	59	60	4	3	4	4	4	4	35	33	37	38	37	36
P.E.I.	44	44	44	45	47	47	6	6	6	6	6	7	50	50	50	49	47	46
N.S.	49	49	47	48	48	48	8	8	8	8	8	8	43	43	45	44	44	44
N.B.	54	54	53	55	55	56	8	7	8	7	7	7	38	39	39	38	38	37
Que.	62	62	61	60	58	61	11	11	12	13	15	16	27	27	27	27	27	23
Ont.	52	51	49	49	49	49	8	9	10	11	12	12	40	40	41	40	39	39
Man.	48	49	48	47	42	46	8	8	8	9	10	10	44	43	44	44	48	44
Sask.	44	48	45	43	47	46	6	6	6	7	7	8	50	46	49	50	46	46
Alta.	45	44	43	42	39	40	9	10	10	11	12	12	46	46	47	47	49	48
B.C.	44	42	43	44	37	42	12	14	13	14	17	16	44	44	44	42	46	42
Yukon	48	37	48	46	41	46	9	9	10	10	12	13	43	54	42	44	47	41
N.W.T.	42	44	44	43	40	40	10	8	8	8	9	9	48	48	48	49	51	51
Canada	53	52	51	50	49	50	9	10	10	11	12	13	38	38	39	39	39	37

^a Percentage adjusted to total 100%.

^a Based on volume of sales of absolute alcohol using the following conversion factors: beer - 5% alcohol by volume, wine - 13% and spirits - 40%.

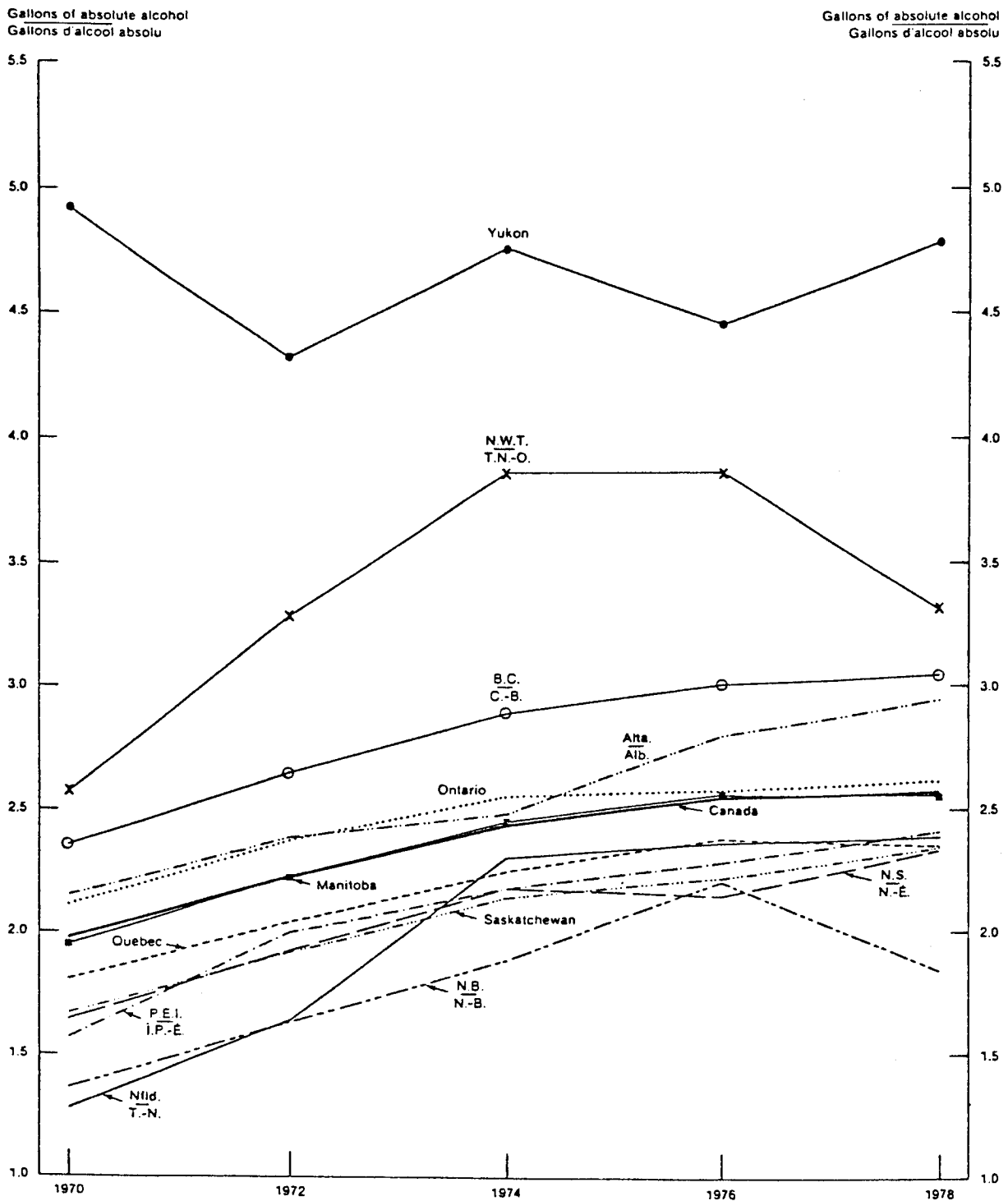
Source: Statistics Canada, The Control and Sale of Alcoholic Beverages in Canada 1978 and 1979 (Ottawa: Statistics Canada Catalogue No. 63-202, 1980 and 1981 respectively).

Source: ARF-1983; p. 46.

FIGURE 1

Per Capita Consumption of Alcoholic Beverages, by Provinces, Canada, 1970-1978

Consommation per capita des boissons alcooliques, selon la province, Canada, 1970-1978



Source: Expert Committee on Alcohol Statistics-1981; p. 4.

Patterns of alcohol consumption (frequency and quantity of drinking, drinking occasions distributed over time, drinking setting, characteristics of those who drink) are less amenable to study. For example, aggregate data such as those above give no indication of the distribution of consumption. Household surveys have provided some information in this regard (Canada Health Survey 1981), but detailed knowledge about the nature and extent of actual drinking practices is very limited (Ouellet, Romeder and Lance 1979). Some major findings about alcohol consumption patterns in Canada are listed below.

- o About 80% of Canadians 15 years of age and over drink alcohol at least occasionally; estimates for those who have 14 or more drinks per week range from 12-27%, men outnumbering women from 2-4 to 1.
- o Men drink more often and more heavily than women, the largest differences occurring in older age groups.
- o The proportion of alcohol users is highest among those 20-39 years of age, declining progressively in older age groups.
- o A higher proportion of married persons reports using alcohol than do single persons, but the single population includes a higher proportion of heavy drinkers.
- o The proportion of alcohol users tends to increase with income. Professional/managerial persons and unemployed/student populations have the highest proportion of alcohol users and heavy drinkers (14 or more drinks/week).
- o The "alcohol-addicted" population in Canada was estimated at 635,000 in 1978, or 1 in 20 Canadian adult drinkers. Alcohol addiction was defined as "a compulsion to take alcohol on a continuous basis to experience its psychological and physical effects and/or to avoid the discomfort of its absence" (Expert Committee on Alcohol Statistics 1981, p. 13).

2.1.2 Benefits and costs of alcoholic beverages. The benefits and costs associated with beverage alcohol in Canada have not been analyzed rigorously. Several studies have concentrated on negative aspects of alcohol use (e.g., Chalmers 1972) but have tended to ignore

certain tangible and intangible positive aspects of alcohol use. Yet, the effectiveness of programs to reduce alcohol-related damage by influencing alcohol consumption or restricting its availability may depend greatly upon the "plus" side of the social equation. The influence of various components of the cost-benefit matrix on alcohol policy has been summarized by Smith (1973) as follows:

When a rational consumer considers a purchase, economists assume that he has perfect knowledge and that he examines the benefits and the costs (money plus other costs, including what other items he gives up)--if the benefits exceed the costs, he makes the purchase. If an individual makes a purchase of an alcoholic beverage, it is assumed (if he is rational) that he has considered the benefits of taste, relaxation of tensions, food value, etc., and the money cost as well as the non-money costs, such as the possibility of embarrassment, physical discomfort and loss of work if he consumes an excessive amount, and has judged that the private benefits outweigh the private costs. It is only the costs that he inflicts on others that are considered as negative externalities, and it is only these costs that would be taken into account in the setting of taxes on commodities by a government whose sole objective was to achieve an efficient allocation of resources (p. 144).

Possibly the most important taxation goal is an optimal allocation of resources, especially as it is affected by "externalities", those benefits or costs received or incurred by third parties to the transaction; for example, the cost to the public of treating alcoholics, the cost of lost industrial time, accidents, etc. The existence of externalities implies some form of government involvement to achieve proper resource allocation: taxes in the case of negative externalities and subsidies in the case of positive externalities. Positive externalities--external benefits from the use of alcoholic beverages--are extremely difficult to quantify, but they include such things as social facilitation and relaxation of tensions.

An analysis of economic effects gives some reason to believe that present government revenues (\$913 million in 1969) from alcoholic beverage taxation exceed the negative externalities associated with alcohol beverage consumption (estimated \$600 million in 1969). This preliminary estimate is based on a small number--and only one in Canada, for New Brunswick--of adequate studies of the cost of alcohol-related problems to society. These studies may well under-estimate the true costs due to externalities. This is one area, among many mentioned

throughout this report, that the Study Committee considers is in need of a much more thorough research effort" (p. 161, emphasis added).

The direct economic benefits associated with widespread consumption of alcohol and the contribution of the alcoholic beverage industry to the economy of Canada are substantial. Alcoholic beverage industries contribute positively to Provincial and Federal economics by providing employment and a readily taxable product. In 1980, over 19,000 persons were employed in alcohol-related work; salaries and wages totalled \$446.5 million (ARF 1983, p. 112). National advertising by breweries, distilleries, and wineries (about \$91 million) provided a substantial source of revenue for the electronic and print media (ARF 1983, p. 111). Moreover, Canadian governments collected over \$2.8 billion in revenue from the control and sale of alcoholic beverages in 1978-79 (Table 2). These figures indicate the volume of sales involved and the level of investment by special interest groups. Federal and Provincial governments, taken as a group, derive between 2 and 3% of their total revenue from alcoholic beverages, and thus remain major stakeholders in the manufacture, sale, and consumption of this product.

Much more difficult to quantify, however, are the somewhat more "intangible" benefits (or in Smith's words, "positive externalities") associated with widespread use of alcoholic beverages: factors such as relaxation, social facilitation, etc. Yet, the very existence of such positive externalities results in public demand for, and increased availability of, alcohol. The magnitude of these benefits (and the value placed on these benefits by consumers) may be quite small in any given instance. They are nonetheless encountered with high degrees of certainty by the vast majority of drinkers. In sharp contrast, the magnitude of disbenefits may be very substantial (death, injury, etc.). Such events have an extremely low probability of occurrence (on any drinking occasion), and, when they do occur, directly involve only a very small minority of drinkers.

Costs to public health and safety include physical, mental, and social health-related problems associated with the use of alcohol. Causes of

Table 2

GOVERNMENT REVENUE DERIVED FROM CONTROL AND SALE OF ALCOHOLIC BEVERAGES,
CANADA AND PROVINCES, 1978-79*

Provincial and Territorial Governments

Province	Net Income from Sales	Sales Tax	Licenses & Permits	Fines & Confiscations	Total Revenue from Control & Sale of Alcoholic Beverages	Alcohol Revenue Per Capita	Alcohol Revenue as a % of Total Government Revenue
(thousands of dollars)							
Nfld.	\$ 21,708	\$ -	\$ 16,679	\$ 117	\$ 38,504	\$ 67.46	3.1
P.E.I.	6,597	2,156	92	350	9,195	75.12	3.5
N.S.	55,776	-	1,595	117	57,488	68.09	3.8
N.B.	40,558	-	2,145	101	42,804	61.38	3.3
Que.	197,907	-	57,084	461	255,452	40.74	1.8
Ont.	358,496	-	115,389	21	473,906	55.97	3.4
Man.	61,927	-	7,906	-	69,833	67.67	3.9
Sask.	63,633	-	451	-	64,084	67.33	3.1
Alta.	153,625	-	6,892	-	160,517	81.23	2.1
B.C.	187,054	-	28,556	-	215,610	84.71	4.2
Yukon	3,150	626	38	-	3,814	175.76	3.7
N.W.T.	5,043	-	383	-	5,426	124.45	2.0
All Prov. & Terr.	\$1,155,474	\$2,782	\$237,210	\$1,167	\$1,396,633	\$ 59.32	2.8

Federal Government

	Excise Tax	Excise Duty	Licenses	Import Duty	All Revenue from Control & Taxation of Alcohol	Alcohol Revenue Per Capita	Alcohol Revenue as a % of Total Government Revenue
(thousands of dollars)							
Beer		\$179,329	\$ 2	\$ 7,355 (e)	\$186,686	\$ 7.93	0.4
Wine	\$10,748			34,903 (e)	45,651	1.94	0.1
Spirits		386,037	13	94,496 (e)	480,546	20.41	1.1
All Alcohol	\$10,748	\$565,366	\$15	\$136,754	\$712,883	\$30.28	1.7

All Governments

Total Revenue ^a	\$2,109,516,000
Per Capita Revenue	\$89.60
Alcohol Revenue as a % of Total Government Revenue	2.3

^a The following Government revenue derived from alcohol are not included: (a) General retail sales taxes levied by most provinces and ranging from 5% to 11% depending on the province. In 1978-79, the tax on retail sales from the provincial selling authority to the consumer was estimated at \$328,653,000.* This figure represents a minimum, as retail sales tax payable on alcoholic beverages sold by dispensers such as taverns and bars for on-premise consumption did not include dispensers markup which varies widely. (b) Provincial and Municipal revenue such as Corporation Income Taxes, Real Estate Taxes and Business Taxes from producers and distributors. (c) Federal taxes on producers and distributors such as the Corporation Income Tax under the Income Tax Act and the general sales tax at the rate of 12% on manufacturers' selling prices plus excise duty for domestic products and on value after duty is paid for imports. Federal and Provincial Corporation Income Taxes for 1978, which was the latest year available, totalled \$95.4 million, that is: \$71.7 million for Distilleries; \$21.4 million for Breweries and \$2.3 million for Wineries.*** The manufacturer's sales tax for beer during 1978 amounted to \$109,416,000.** For wine and spirits which are liable to be submitted to an "aging" process, the manufacturer's sales tax cannot be readily estimated. The amount of this tax payable on the excise duty or the import duty alone would be in the order of \$61,852,000 in 1978-79.* In the case of beer an additional \$127,650,000 were levied during 1978 as gallonage tax.** Government revenue derived from alcohol during 1978-79 was in excess of \$2.8 billion.

Sources: Statistics Canada, The Control and Sale of Alcoholic Beverages in Canada 1978* (Ottawa: Statistics Canada Catalogue No. 63-202, 1980); Statistics Canada, Breweries 1978** (Ottawa: Statistics Canada Catalogue No. 32-205, 1980); Statistics Canada, Corporation Taxation Statistics 1978*** (Ottawa: Statistics Canada Catalogue No. 61-208, 1981); Statistics Canada, Federal Government Finance 1978 (Ottawa: Statistics Canada Catalogue No. 68-211, 1980); Statistics Canada, Provincial Government Finance - Revenue and Expenditure 1978 (Ottawa: Statistics Canada Catalogue No. 68-207, 1981).

mortality and morbidity directly attributable to alcohol include liver cirrhosis, alcoholism, alcohol psychosis, and alcohol poisoning. Some forms of cancer as well as heart, respiratory, and neurological diseases have been indirectly linked to chronic alcohol use and associated nutritional deficiencies. Alcohol-related disabilities, both acute and chronic, include impairment in physical, mental, and social functioning. Impairment can manifest, for example, as child abuse, marital discord, occupational difficulties, social aggression, suicide, and violent crimes (Expert Committee on Alcohol Statistics 1981).

Figure 2 presents one set of official estimates of alcohol-related deaths in Canada.

In examining mortality statistics, it is estimated that alcohol use was directly implicated in 2,520 deaths in 1978. Included were deaths from alcoholism, alcohol psychosis, cirrhosis and alcohol poisoning. Indirect alcohol-related deaths amounted to 5,668 deaths from such events as motor vehicle accidents, falls, fires, drowning, homicides and suicides. Additional deaths in which alcohol may be a factor, including such medically diagnosed categories as coronary and respiratory diseases, and various types of cancers, amounted to 10,142 deaths.

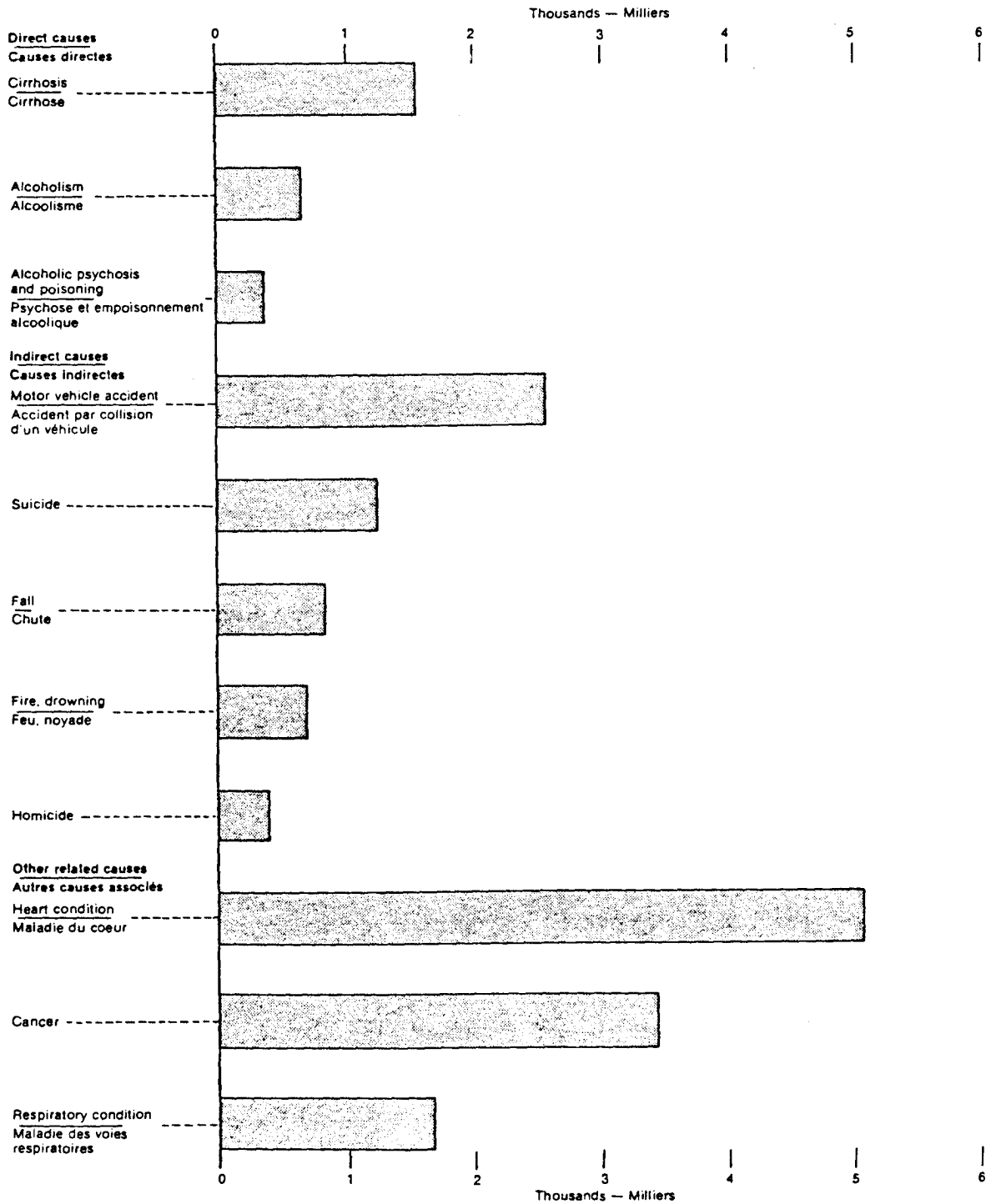
These alcohol-related fatalities in 1978 are estimated at over 18,000 deaths. In summary, an estimated 1 out of every 11 Canadians (10.9%) died from an alcohol-related condition whether directly (1 in 60) or indirectly (1 in 10) (Expert Committee on Alcohol Statistics 1981, p. 15)

Ouellet et al. (1979) attributed 6% (4,716) of the total deaths (73,440) in Canada in 1974 to "hazardous drinking". About 18% of Canadian premature mortality was attributable to alcohol, including only causes of death strongly related to its use. Most recent data indicate the "the number of deaths in Canada classified as directly attributable to alcohol reached 3,512 in 1979 and 3,458 in 1980. Of these, approximately 76% to 78% are due to liver cirrhosis and most of the remainder to alcohol dependence syndrome (14%), with about 4% due to non-dependent abuse of alcohol" (ARF 1983, p. 11). Death rates from three conditions directly related to alcohol per 100,000 population aged 20 and over were: 0.2 (alcoholic psychosis), 3.0 (alcohol dependence syndrome), and

FIGURE 2

Estimated Alcohol Related Deaths, Canada, 1978

Estimation des décès dus à la consommation d'alcool, Canada, 1978



Source: Expert Committee on Alcohol Statistics-1981; p. 16.

16.7 (liver cirrhosis) in 1980 in Canada. These deaths represented 2% of total deaths for all diagnostic categories (ARF 1983, pp. 11,57).

The Statistical Information Section of the Addiction Research Foundation (ARF) of Ontario has compiled extensive data on morbidity associated with alcohol use in Canada (ARF 1983). Indicators of morbidity directly attributable to alcohol included (1) hospital separations (discharges) and patient-days and (2) admissions, readmissions, and patient-days in inpatient psychiatric facilities. In 1978, about 47,000 discharges from hospitals were accounted for by alcohol-related cases: alcoholism (70%), liver cirrhosis (25%), and alcoholic psychosis (8%). Relative to totals for all diagnostic categories, alcohol-related cases accounted for 1.3% of hospital discharges and 1.6% of patient-days. Alcohol-related problems accounted for about 17% of first admissions and 14% of readmissions to inpatient psychiatric hospitals, and for 3.6% and 2.9% of patient-days, respectively. (There is some overlap between data sources used in developing these figures; the original report [ARF 1983] should be consulted for a discussion of these data and their limitations.)

Information on the association between alcohol use and adverse effects on public safety--with the exception of traffic accidents, the subject of this report--seems less reliable (Ouellet et al. 1979). Industrial accidents, violent crime, falls, drownings, and fires are among the safety-related categories in which alcohol use can be a factor (Gerson 1978; Gerson and Preston 1979).

Yet, despite the widespread occurrence of "alcohol-related" damage, the major forms of this damage (as outlined above) are best construed as "rare" events, affecting only the small minority of drinkers. Certainly, if they are denominated in terms of absolute probabilities of occurrence per drinking occasion, the likelihood that they will be experienced is minimal.

2.1.3 Summary. Alcoholic beverages play an integral role in society. Moreover, alcohol is the only "recreational" drug both social-

ly and legally accepted in society. Its widespread use for many purposes, including intoxication, seems firmly rooted, and public policy presently reflects public demand for its continued availability. Alcohol-related health and safety problems affect many, but only a small percentage of those who use alcohol. Moreover, based on prevailing public attitudes and practices, general tolerance for the present level of personal and social costs connected with beverage alcohol seems implied. We might infer that, so far as society as a whole is concerned, benefits outweigh costs.

A dilemma hardly new or novel presents itself: how to satisfy the express demand for alcoholic beverages among the general population and still minimize their adverse effects among those who consume excessive quantities or who use alcohol in inappropriate settings. Resolving this dilemma has fallen largely to policymakers who, in the face of competing interests and public pressure, are asked to decide how--and if--something effective can be done. The complexities surrounding the patterns of use of alcoholic beverages and the maze of existing alcohol control policies should not be minimized, especially by those who concern themselves with specific alcohol-related problems with much narrower focus, such as the area of alcohol and traffic safety. At the same time, given the broader social context and the importance attached to alcoholic beverages, a balanced and realistic appraisal of population rates of alcohol-related problems seems warranted.

2.2 Motor Vehicle Transportation in Canada

In contrast to the history of alcoholic beverages, the "Age of the Motorcar" dawned suddenly on the post-industrial world (Borkenstein et al. 1964). The development of an extensive, ever improved road transportation system supported the proliferation of motorized vehicles. The private automobile came to represent the freedom to travel, personal mobility, and rapid, convenient, comfortable transfer from point to point. At a societal level, the motor vehicle increasingly became an integral component of transportation, commerce, and recreation. The extent of integration of the motor vehicle into various areas of the

Canadian economy is illustrated by the fact that in the top ten industries (which together accounted for 43.5% of total manufacturing shipping in 1979), manufacturers of motor vehicles and motor vehicle parts and accessories ranked second and seventh, respectively (Statistics Canada 1981).

2.2.1 The road transportation system. In 1980-1981, Canada had about 270,000 kilometres of highways and roads under federal or provincial jurisdiction and about 660,000 kilometres of roads and streets under municipal jurisdiction (Table 3) (Roads and Transportation Association of Canada 1983).

Registrations of motor vehicles in Canada (a measure approximating their actual number and including passenger cars, trucks, buses, motorcycles and mopeds [where registered]) totalled about 13,684,000 in 1982. Automobiles comprised 75% or 10,255,000 of the total registrations, which have increased 26% since 1974. These figures are only approximate due to interprovincial differences in vehicle registration and various difficulties in collecting complete and accurate data (Statistics Canada 1981). Nevertheless, they indicate the size of the road transportation system.

Other indicators provide gross estimates of the system's use (Figure 3 to Figure 5). In Canada, with a population of 24.6 million, 14,379,000 driver licenses were in force in 1982 (Transport Canada 1982). Figure 3 presents data that show the steady increase in the number of licensed drivers. The year 1982 featured a slight decrease in this statistic for the first time since 1960. Motive fuel sales are used to estimate, indirectly, the number of vehicle kilometres traveled (VKT); the consistent, yearly increase in VKT (until 1979) reflected the growth of the system and the number of its users (Figure 4). Figure 5, which presents data on the ratio of VKT to licenced drivers, indicates that, on the average, people in Canada have made increasing use of the system. The economic recession in recent years, however, seems to have had a substantial impact on these trends.

Table 3
Federal, Provincial and Municipal
Highway Kilometers,
Canada and Provinces, 1980-81

	Total	B.C.	ALTA.	SASK.	MAN.	ONT.	QUE.	N.B.	P.E.I.	N.S.	NFLD.
	km	km	km	km	km	km	km	km	km	km	km
HIGHWAY INVENTORY											
<u>Federal Highways</u>											
Freeway	27	—	27	—	—	—	—	—	—	—	—
Arterial	2,049	1,339	467	6	54	—	—	—	—	—	162
Collector	700	23	270	49	61	64	56	21	28	90	38
Local	8,047	742	1,959	2,189	1,050	1,349	350	144	90	120	54
Total Length (km)	10,823	2,104	2,723	2,244	1,165	1,413	406	186	118	210	254
<u>Provincial Highways</u>											
Freeway	4,912	293	239	—	—	2,023	2,234	—	—	123	—
Arterial	62,869	10,340	12,855	4,150	6,500	12,813	9,312	2,136	410	2,422	931
Collector	55,045	11,214	2,781	4,950	11,960	5,345	9,268	2,323	770	4,620	2,814
Local	133,266	20,552	22,456	11,100	365	382	38,208	13,257	3,760	18,022	5,165
Total Length (km)	256,092	42,399	39,331	20,200	18,825	21,563	58,021	17,716	4,940	25,188	8,910
<u>Municipal Highways</u>											
Total Length (km)	661,343	18,011	211,216	156,000	64,000	138,580	65,120*	2,638	554	2,127	3,097
Grand Total (km)	928,258	62,514	252,270	178,444	83,990	161,555	123,547	20,540	5,612	27,525	12,261
% of Total	—	6.7	27.2	19.2	9.0	17.4	13.3	2.2	0.6	3.0	1.3

* Estimate

Source: RTAC - 1983; p.4.

FIGURE 3
LICENCED DRIVERS (100,000)

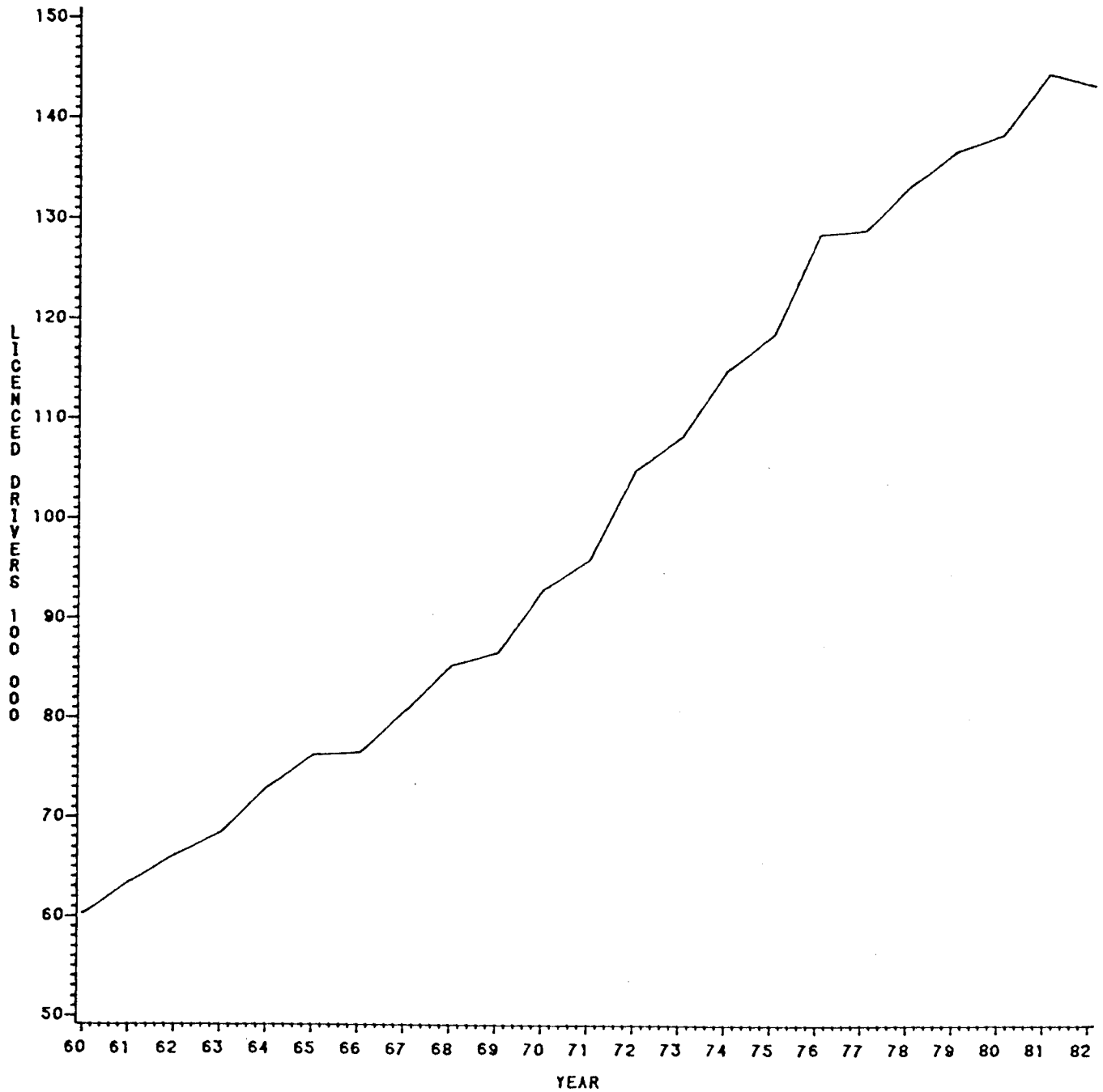


FIGURE 4

VEHICLE KILOMETERS TRAVELLED (1,000,000,000)

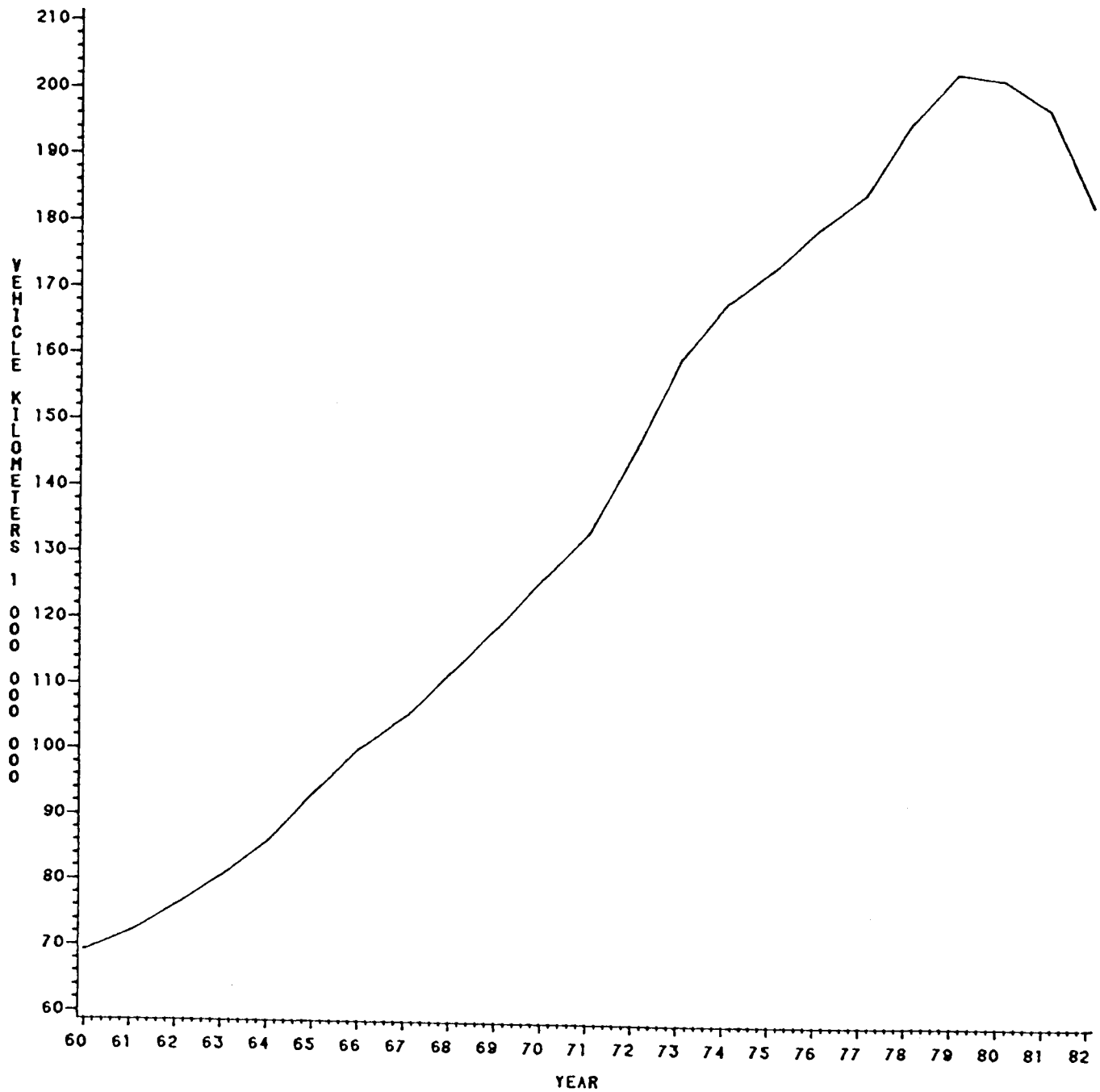
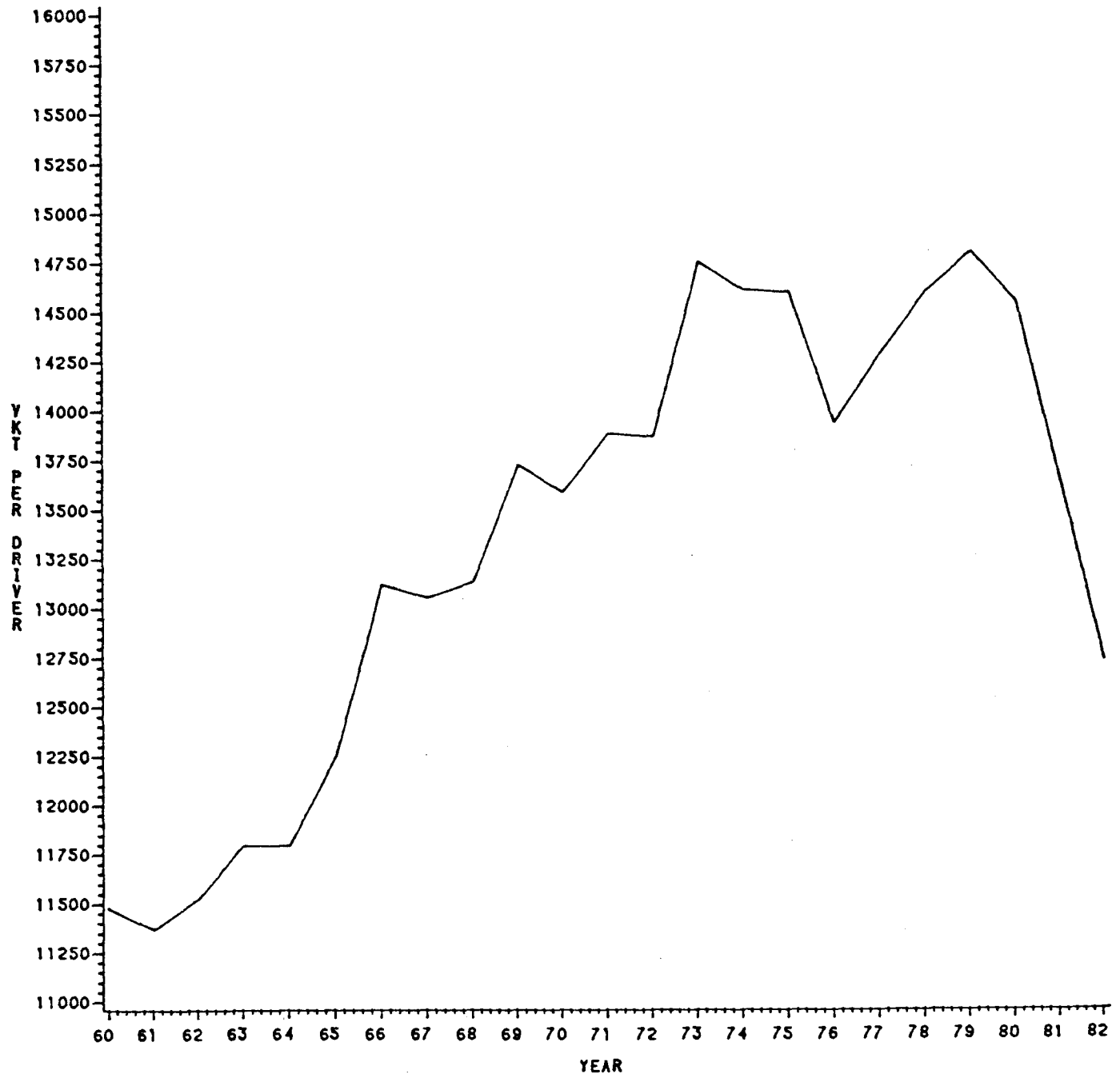


FIGURE 5

VEHICLE KILOMETERS TRAVELLED PER LICENCED DRIVER



2.2.2 Benefits and costs of road transportation. The road transportation system represents a substantial investment of public funds as well as a significant source of provincial revenue. Tables 4 and 5 present data on expenditures for roadway construction, maintenance, and administration for 1975 and 1976. The total expenditures in 1976 (\$4.4 billion) was an increase of 17% over 1975 (Statistics Canada 1981). By 1980-1981, expenditures for highways in Federal and Provincial systems were about \$2.9 billion, compared to about \$2.4 billion in 1976 (Roads and Transportation Association of Canada 1983). Comparable figures for total expenditures for municipal systems were not available. Provincial revenue from vehicle and driver licencing, fuel taxes, and other sources was about \$2.2 billion in 1976 (Table 6).

A comprehensive cost-benefit analysis of road transportation in Canada, to our knowledge, has not been done. Such an analysis, of course, would be a major undertaking, given the wide range and diversity of relevant economic, personal and social factors. This could be likened to doing a cost-benefit analysis of the human circulatory system for organic well-being! Road transportation, especially private motor vehicle use, plays an essential role in day-to-day life and its many aspects.

As noted before, benefits from motor vehicle transportation include individual freedom, personal mobility, economic opportunity (e.g., through mobility of labor), and socialization. Unfortunately, there is no acceptable methodology for estimating the value placed by individuals upon incremental improvements in such "commodities". We can, however, assume that the benefits of the transportation system are substantially in excess of the costs of supply. In other words, the sum of individual and corporate benefits greatly exceeds the level of expenditure (Samuelson 1954, 1966; Schelling 1973; Frohlich et al. 1975). Moreover, the benefits accrue to most, if not all, individuals, and "investments" are "rewarded" with a high degree of certainty.

Costs associated with the transportation system in Canada, even if less than its benefits, are great. The expenditures on roadway construction, maintenance, and administration are only a fraction of the total costs.

Table 4

Construction, maintenance and administration expenditure on roads and streets, by province, years ended Mar. 31, 1975 and 1976 (thousand dollars)

Item and province or territory	Construction		Maintenance and administration		Total expenditure	
	1975	1976	1975	1976	1975	1976
EXPENDITURE ON PROVINCIAL, FEDERAL AND OTHER UTILITY ROADS ^{1,2}	1,514,888	1,511,393	704,649	912,836	2,219,537	2,424,229
Newfoundland	49,570	55,976	32,977	59,906	82,547	115,882
Prince Edward Island	6,974	8,164	9,983	12,350	16,957	20,514
Nova Scotia	55,546	51,885	41,702	69,867	97,248	121,752
New Brunswick	84,082	75,751	39,190	52,075	123,272	127,826
Quebec	539,467	512,504	203,254	250,775	742,721	763,279
Ontario	369,545	326,303	144,472	181,186	514,017	507,488
Manitoba	36,115	46,437	44,407	59,507	80,522	105,944
Saskatchewan	65,029	72,036	33,920	45,211	98,949	117,247
Alberta	157,453	170,705	53,579	43,401	211,032	214,106
British Columbia	126,241	164,344	85,909	120,331	212,150	284,674
Yukon and Northwest Territories	24,867	27,288	15,257	18,228	40,124	45,516

Table 5

Construction, maintenance and administration expenditure on roads and streets, by province, years ended Mar. 31, 1975 and 1976 (thousand dollars) (concluded)

Item and province or territory	Construction		Maintenance and administration		Total expenditure	
	1975	1976	1975	1976	1975	1976
EXPENDITURE ON MUNICIPAL ROADS ^{1,2}	761,764	945,859	822,696	1,078,951	1,584,460	2,024,810
Newfoundland	7,176	11,829	7,732	13,144	14,908	24,973
Prince Edward Island	747	489	1,262	1,697	2,009	2,186
Nova Scotia	13,292	13,689	12,805	16,252	26,097	29,941
New Brunswick	19,728	25,041	14,850	20,678	34,578	45,719
Quebec	163,230	199,435	203,403	260,974	366,633	460,409
Ontario	309,229	377,508	340,866	418,223	650,095	795,731
Manitoba	42,263	42,571	35,706	49,747	77,969	92,318
Saskatchewan	33,938	49,703	54,899	76,224	88,837	125,927
Alberta	99,598	140,040	97,031	136,725	196,629	276,765
British Columbia	69,587	83,283	52,498	81,960	122,085	165,243
Yukon and Northwest Territories	2,976	2,271	1,644	3,327	4,620	5,598

¹Includes small amounts paid by private companies and other organizations in connection with railway grade crossings and overpasses.

²Provincial and federal subsidies to municipalities amounted to \$437 million in 1975 and \$483 million in 1976 and should be added to provincial and federal expenditures and subtracted from municipal expenditures to arrive at net expenditures for the respective levels of government.

³Fiscal year for municipalities ends the previous Dec. 31.

Source: Statistics Canada-1981; p. 575.

Table 6

Provincial revenue from the registration and operation of motor vehicles, by province, for the licence years 1975 and 1976 (dollars)

Year, province or territory	Motor vehicle licences and fees ¹	Chauffeur and driver licences	Public service vehicle fees ²	Motive fuel taxes	Other ³	Total	Commission allowed gasoline agent ⁴
1975							
Newfoundland	6,542,754	689,689	237,907	34,279,964	1,434,950	43,185,264	134,819
Prince Edward Island	2,093,808	139,388	88,904	8,219,308	323,591	10,864,999	84,260
Nova Scotia	17,282,697	1,146,256	431,411	56,038,671	1,663,415 ⁵	76,562,450 ⁶	387,231
New Brunswick	14,539,947	646,450	"	46,216,319	1,272,642	62,675,358	249,450
Quebec	130,550,185	9,861,779	8,220,630	419,771,055	7,821,418	576,225,067	2,161,712
Ontario	189,152,204	9,849,539	8,917,226	577,986,806	27,607,883	813,513,658	"
Manitoba	12,599,122	1,634,507	4,655,120	58,205,912	217,728	77,312,389	288,961
Saskatchewan	19,435,889	1,002,402	"	45,329,084	2,887,692	68,655,067	760,111
Alberta	34,592,239	1,984,752	250,386	82,429,202	4,552,784	123,809,363	990,491
British Columbia	46,043,434	1,972,877	769,425	170,910,080	18,751 ⁷	219,714,567 ⁷	1,431,378
Yukon	786,859	43,381	214,771	3,384,029	491,206	4,920,246	—
Northwest Territories	419,102	30,846	114,754	2,626,736	165,631	3,357,069	—
Canada	474,038,240	29,001,866	23,900,534	1,505,397,166	48,457,691⁷	2,080,795,497⁷	6,488,413
1976							
Newfoundland	8,096,579	1,085,720	241,338	37,708,103	921,009	48,052,749	"
Prince Edward Island	2,027,830	143,533	90,055	8,319,836	356,746	10,938,000	84,894
Nova Scotia	19,560,952	1,154,890	415,550	57,565,494	2,462,899	81,159,785	379,433
New Brunswick	14,637,785	667,486	187,800	49,475,481	1,334,678	66,303,230	245,285
Quebec	156,126,154	10,088,008	7,453,239	424,317,276	11,237,156	609,221,833	2,178,699
Ontario	213,097,383	8,761,797	7,190,289	587,093,466	33,419,607	849,562,542	"
Manitoba	13,701,092	1,898,260	5,079,220	65,609,649	—	86,288,221	317,392
Saskatchewan	19,240,248	970,034	"	59,018,176	1,865,300	81,093,758	597,834
Alberta	37,770,494	2,941,866	457,683	90,585,421	6,318,178	138,073,642	1,068,925
British Columbia	53,268,814	1,952,387	786,231	177,243,791	3,723,935	236,975,158	1,426,163
Yukon	817,354	72,108	116,649	2,882,392	258,522	4,147,025	—
Northwest Territories	454,511	42,183	90,505	3,963,218	—	4,550,417	—
Canada	538,799,196	29,778,272	22,108,559	1,563,782,303	61,898,030	2,216,366,360	6,298,625

¹Includes passenger cars, motor trucks and buses, motorcycles, other motor vehicles, trailers and transfer of motor vehicle ownership.

²Includes passenger and freight.

³Includes gasoline or service station licences, garage licences, fines for infractions of motor vehicle act and other miscellaneous revenue.

⁴Deducted from gross tax collections to obtain motive fuel taxes.

⁵Included with motor vehicle licences and fees.

⁶Commission payments discontinued, effective May 1, 1972.

⁷Commission payments discontinued, effective Nov. 25, 1975.

Source: Statistics Canada-1981; p. 576.

Deaths, injuries, and disability resulting from motor vehicle accidents are major concerns in the area of public health and transportation safety. A study in the United States estimated the direct and indirect economic costs of motor vehicle injuries at \$14.1 billion, after cancer (\$23.1 billion) and before coronary heart disease (\$13.7) (Hartunian et al. 1980). The cost to the Canadian economy of road accidents was estimated to exceed \$2.5 billion, including lost productivity, property damage, and hospital and medical costs (Transport Canada 1978).

Data on mortality and morbidity arising from traffic accidents indicate these costs have tended to increase over the years. In 1982, motor vehicle fatalities and injuries (vehicle occupants and pedestrians) reported in Canada totalled 4,169 and 225,717, respectively, decreasing in recent years since 1979 and 1980 (Figures 6 and 7). Population rates of motor vehicle fatalities and injuries in Canada were about 17 and 916 per 100,000, respectively, in 1982 (Figures 8 and 9). These rates have remained relatively constant until 1982, when substantial drops occurred.

The number and type of motor vehicle accidents provide measures related to public safety in road transportation. Figures 10, 11 and 12 present data on the total number of fatal, injury, and property damage accidents reported in Canada. These accidents occurred in a ratio of about 1:35:115 in 1979. The ratio of fatal to injury accidents was 1:44 in 1982. Property damage accidents, often overshadowed by injury and (especially) fatal accidents, represent a substantial proportion of societal costs in the field of automobile insurance. Canadian totals for property damage accidents have not been reported since 1979. Fatal, injury, and property damage accidents per 100,000 licensed drivers were about 37, 1,300, and 4,200 in 1979 (Figures 13, 14 and 15). Fatal and injury accidents per 100,000 licenced drivers were about 25 and 1090 in 1982.

From the perspective of public health and safety, the costs of road transportation have increased dramatically since 1960. Major societal initiatives in traffic safety occurred in the late 1960's when general

FIGURE 6
TRAFFIC ACCIDENT FATALITIES

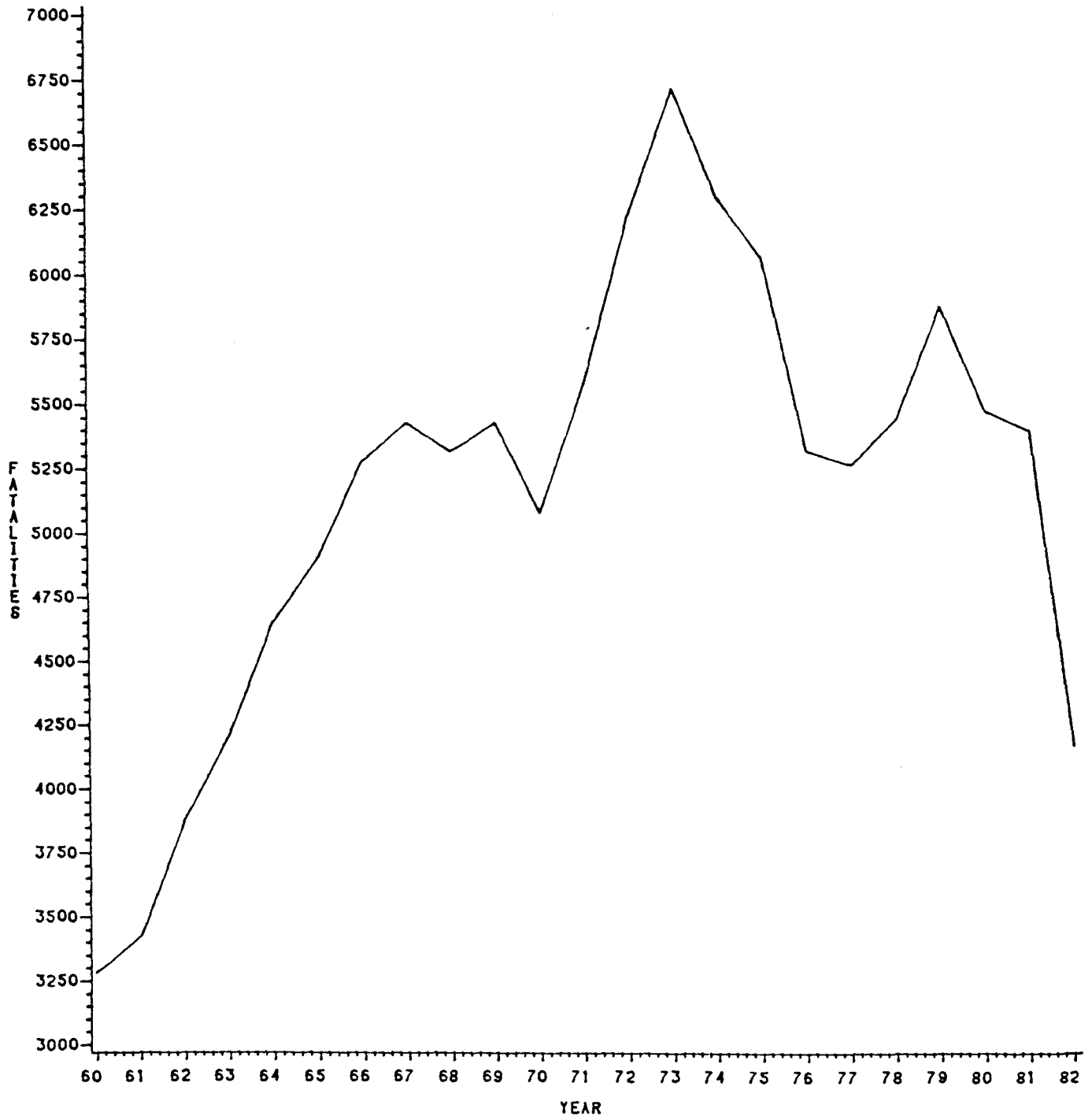


FIGURE 7
TRAFFIC ACCIDENT INJURIES

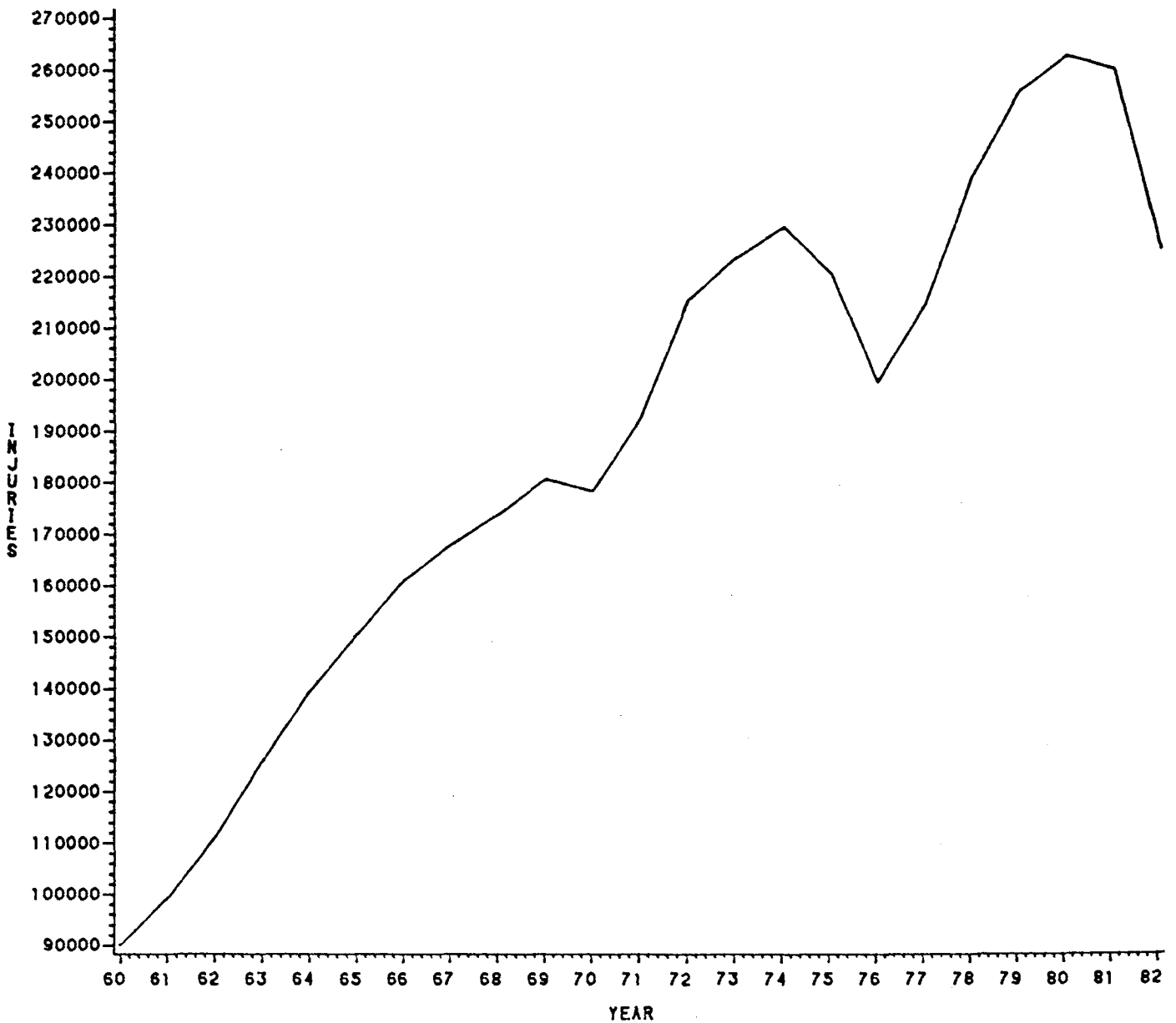


FIGURE 8

FATALITIES PER 100,000 POPULATION

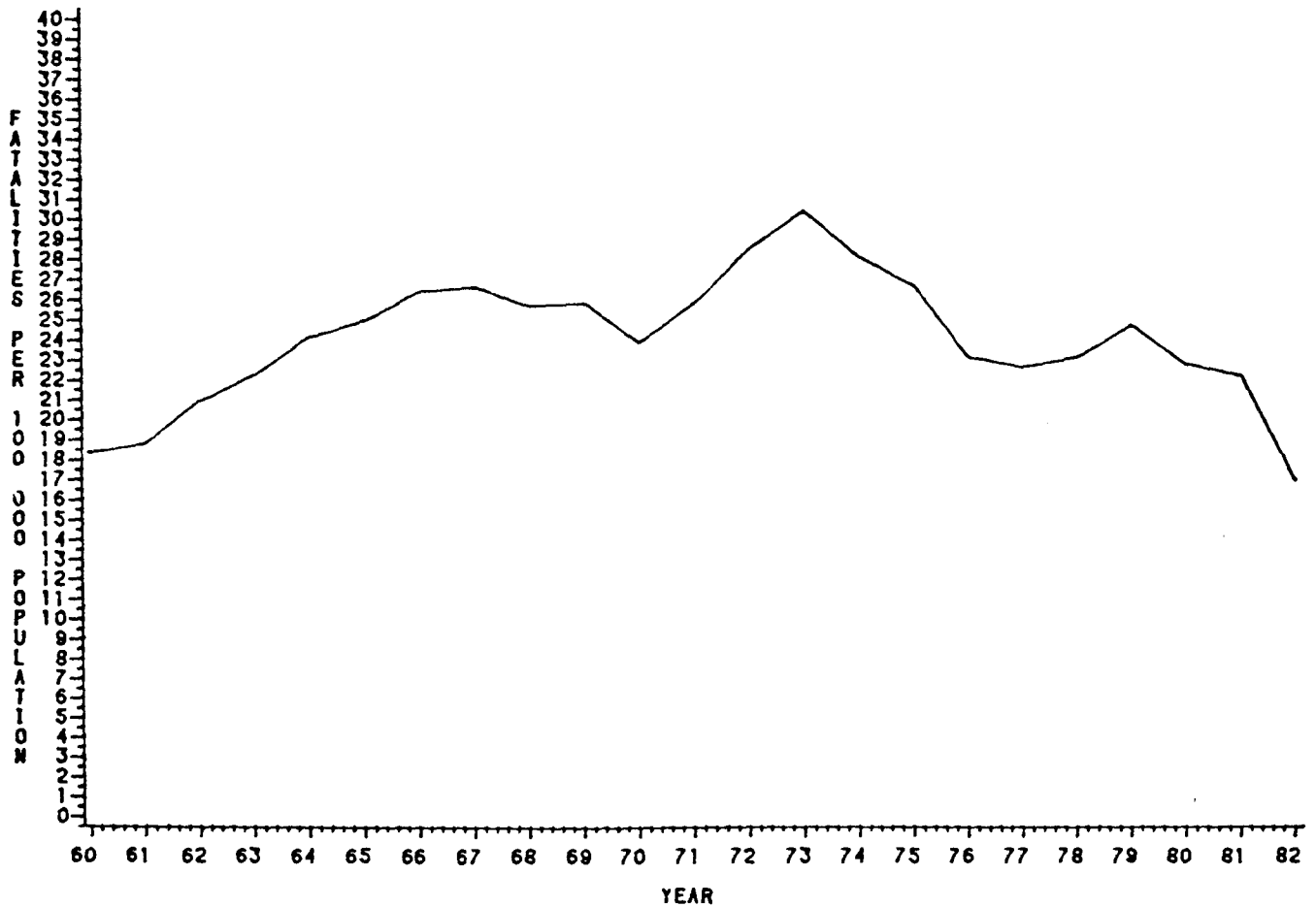


FIGURE 9

INJURIES PER 100,000 POPULATION

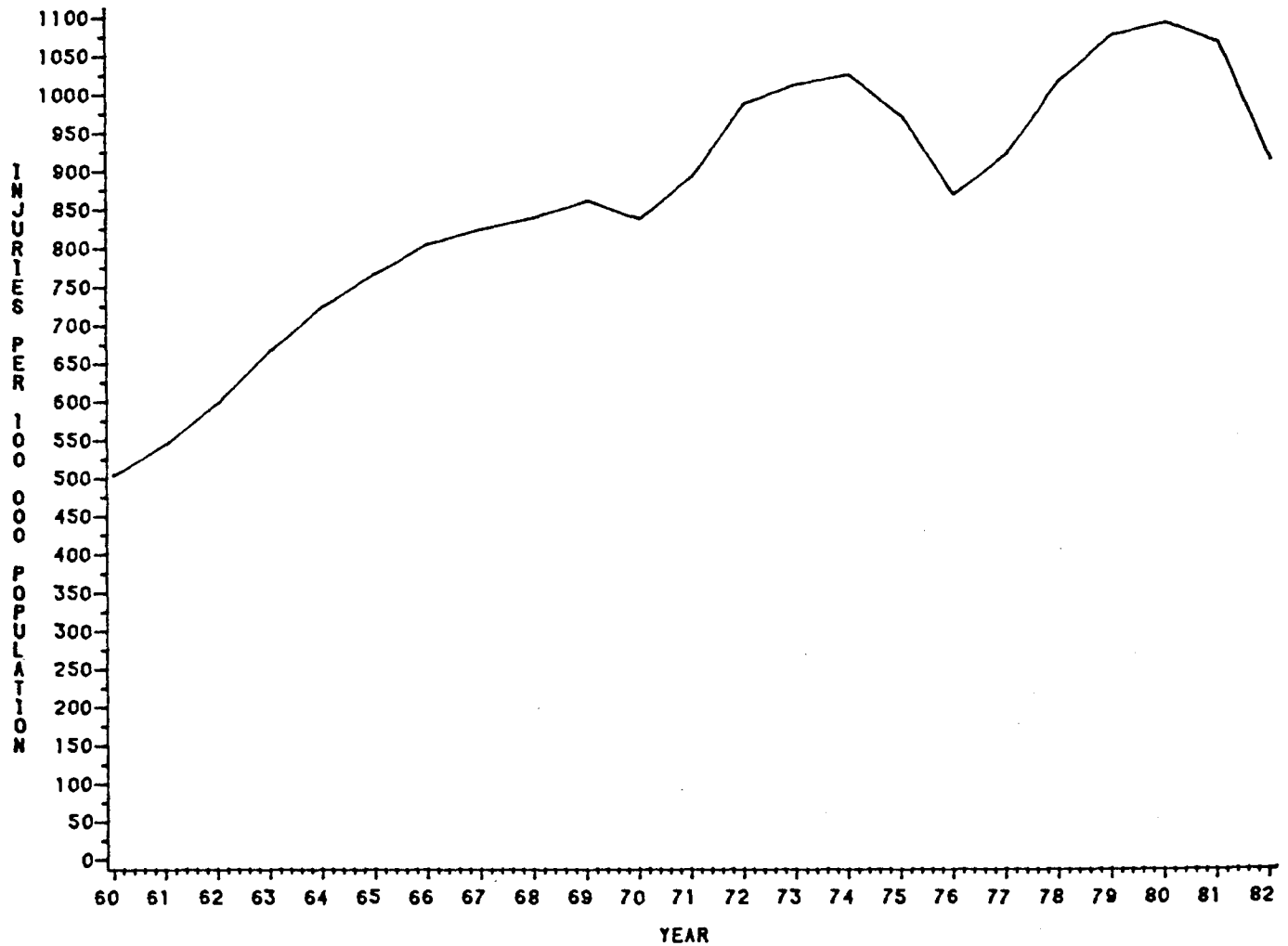


FIGURE 10
FATAL ACCIDENTS

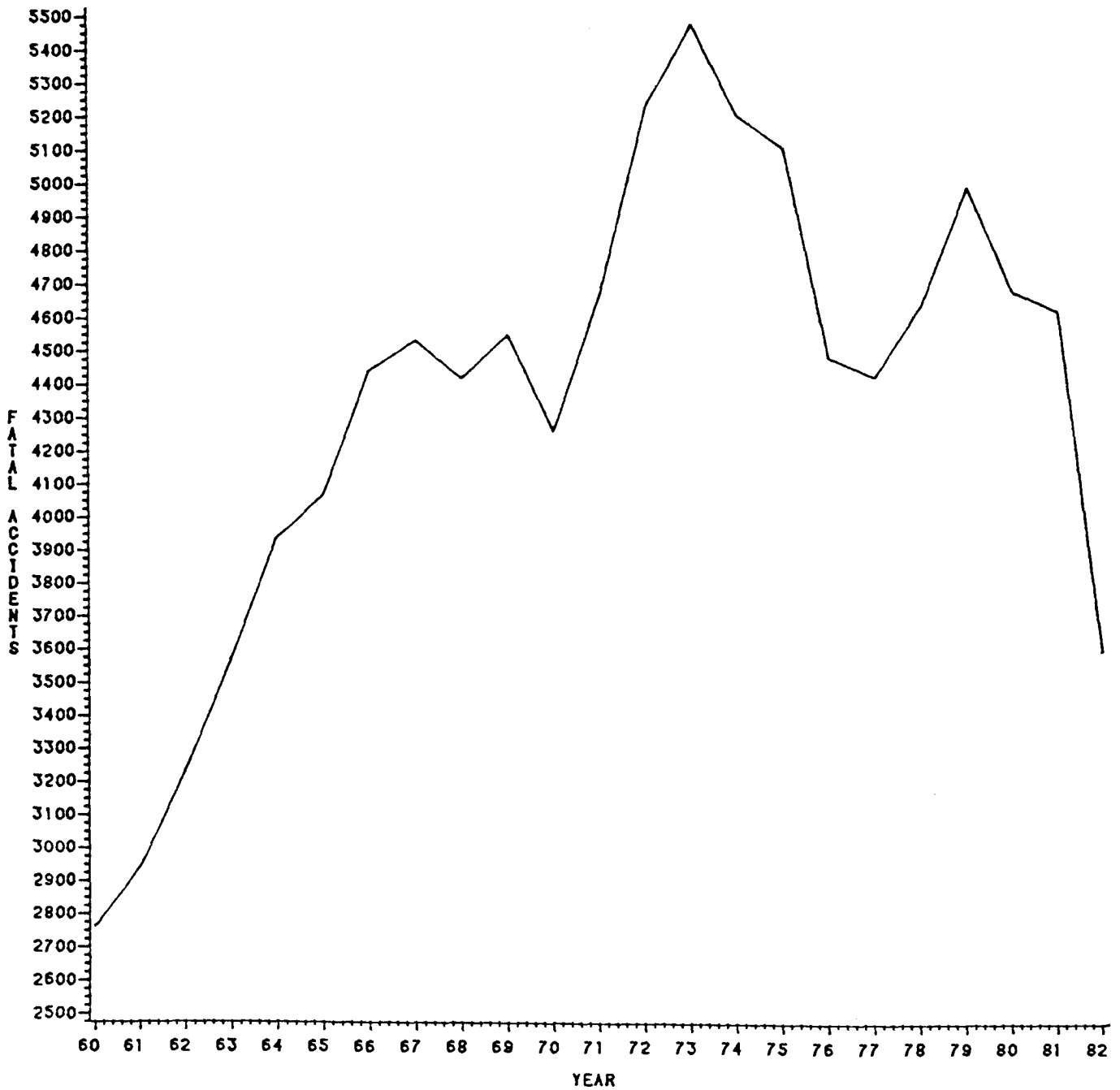


FIGURE 11
INJURY ONLY ACCIDENTS

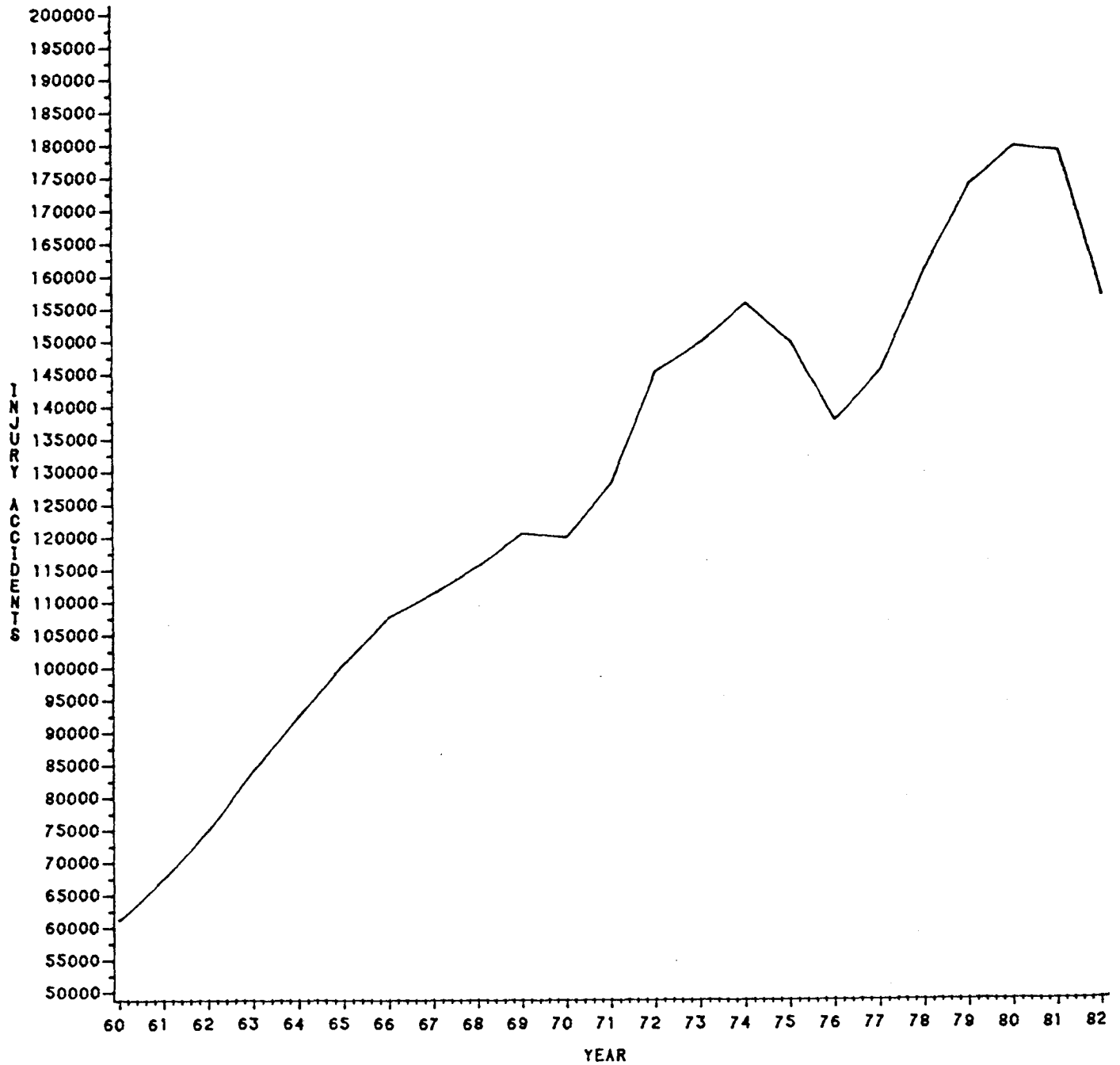


FIGURE 12
PROPERTY DAMAGE ACCIDENTS

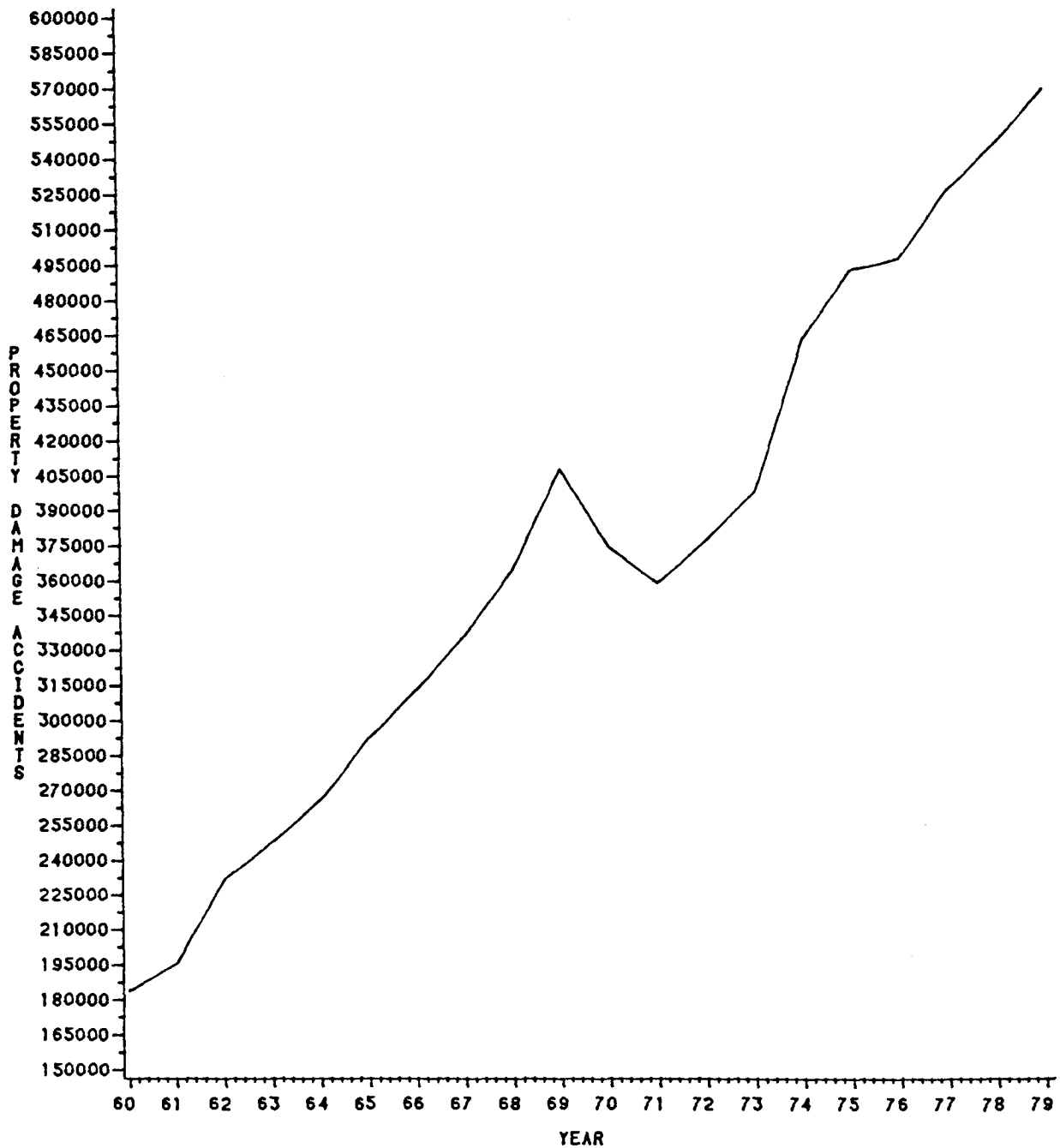


FIGURE 13

FATAL ACCIDENTS PER 100,000 LICENCED DRIVERS

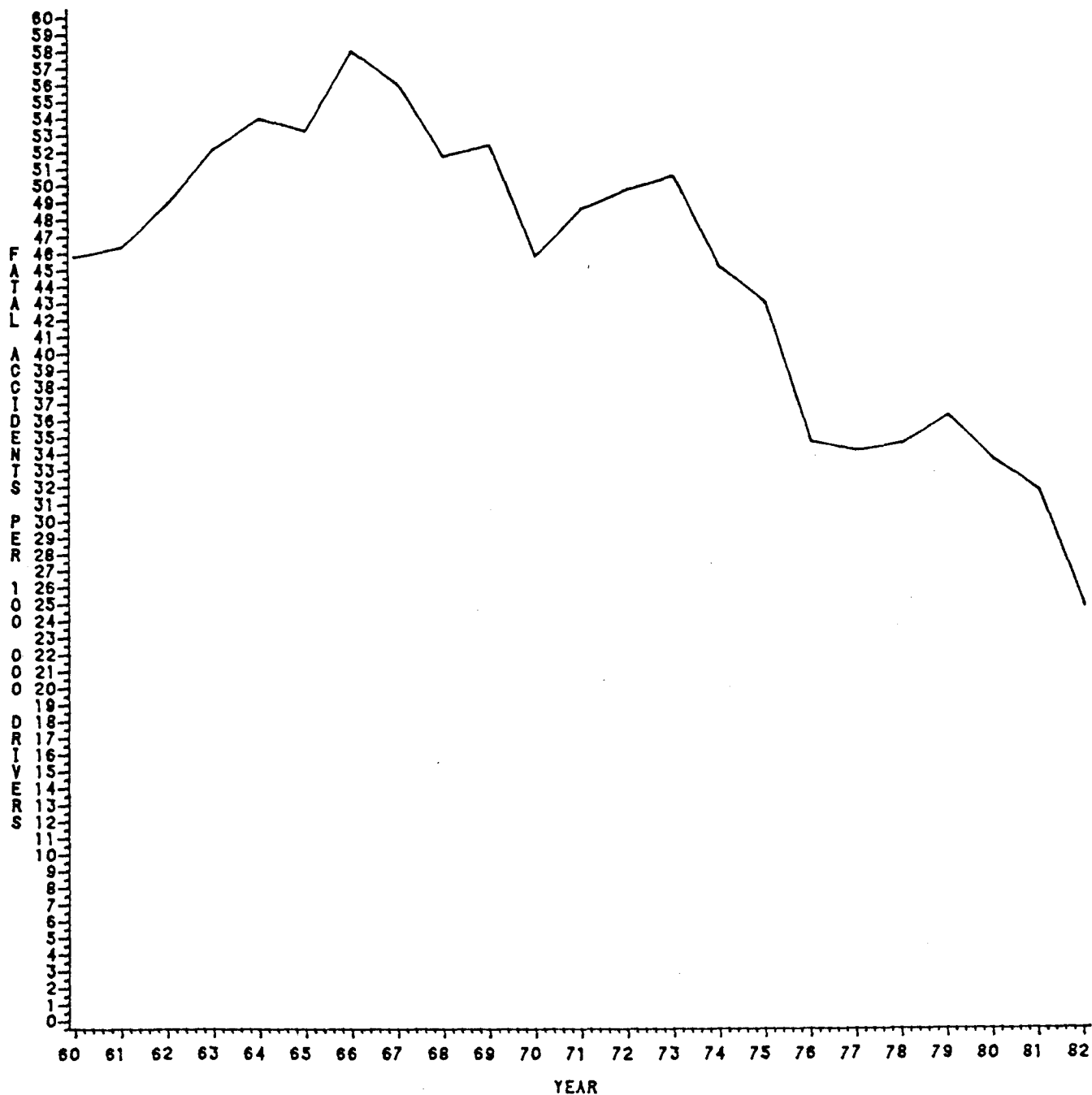


FIGURE 14
INJURY ACCIDENTS PER 100,000 LICENCED DRIVERS

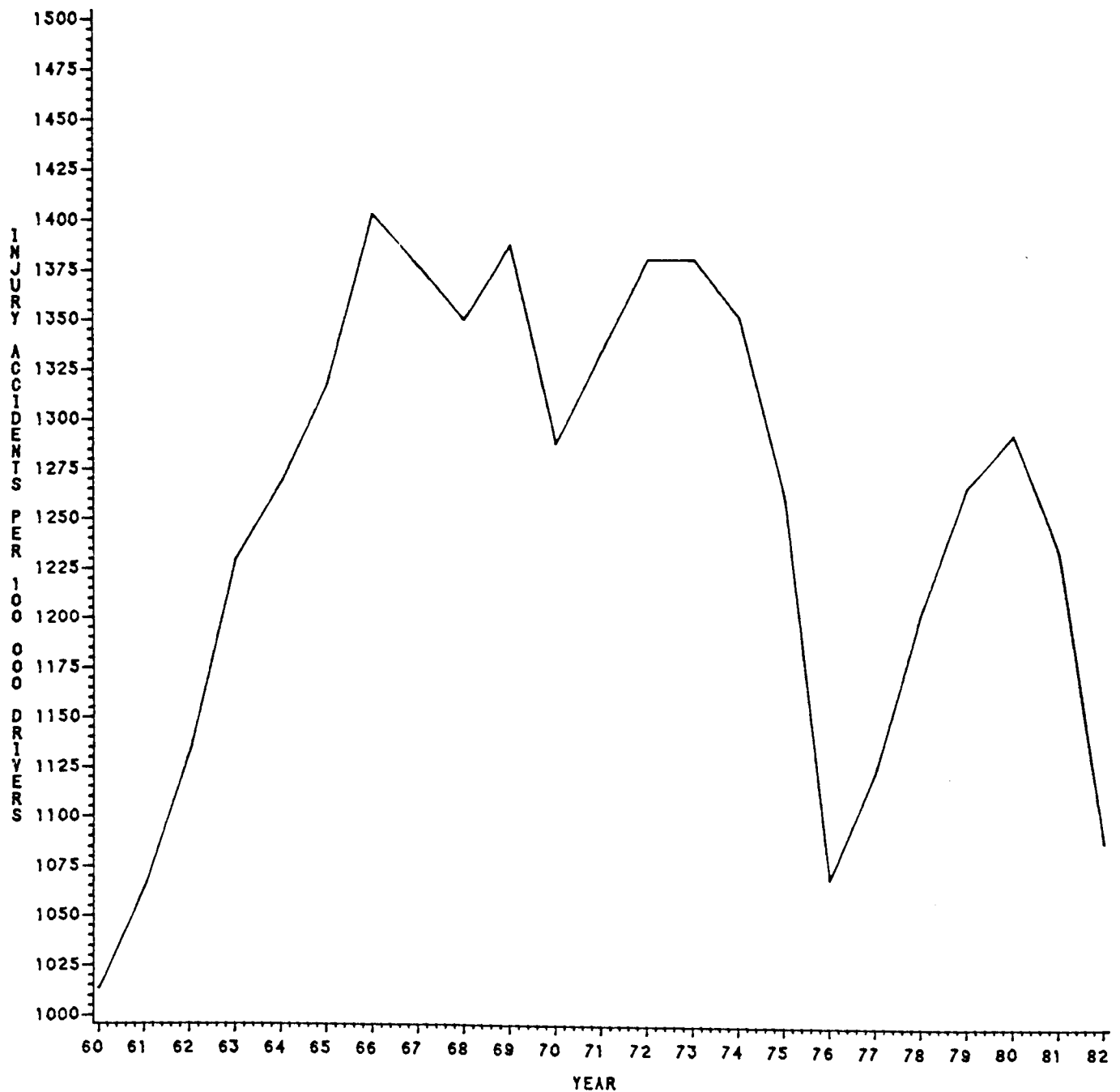
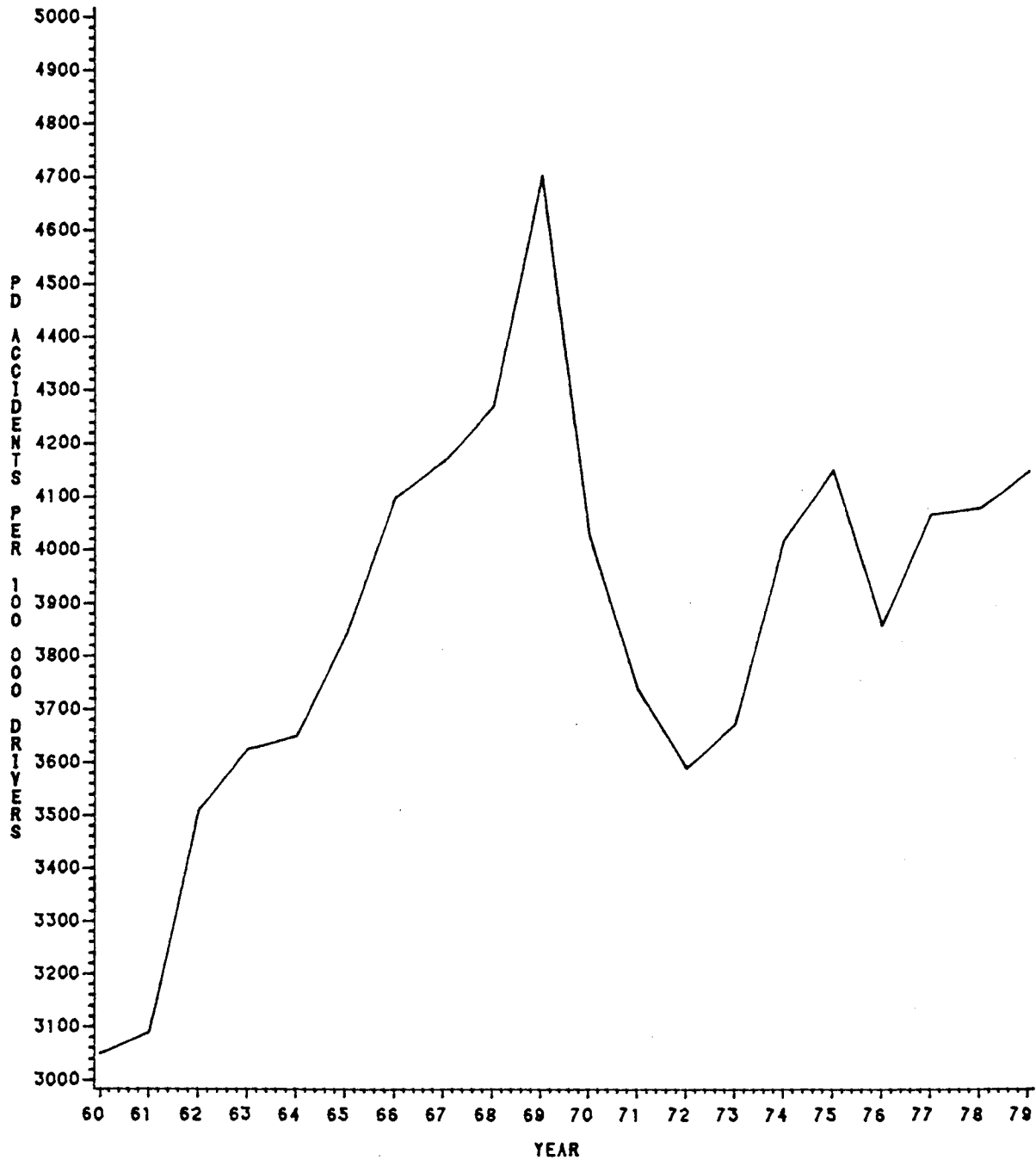


FIGURE 15

PROPERTY DAMAGE ACCIDENTS PER 100,000 LICENCED DRIVERS



public support for programs to reduce the yearly death toll intensified. Yet, the magnitude of health- and safety-related problems has not been reduced substantially. Recent decreases in accident and casualty rates may be more than offset by increases in health care, motor vehicle repair, and insurance costs. Indeed, the road transportation system has functions that appear to conflict with solely health-related objectives. For example, expanding the system to accommodate more people and more motor vehicles and to serve more efficiently a greater geographical area increases exposure to accident risk and, therefore, its associated costs.

Nevertheless, because the transportation system is essential to the structure and functions of society and is used so extensively, the relative magnitude of the road accident problem appears small and, in general, the overall performance of the system seems to increase positively. For example, although deaths and injuries have continued to increase (with a few notable exceptions), accident and casualty rates per 100 million vehicle kilometres travelled (VKT) has declined steadily since the mid- to late-1960's, as shown in Figures 16 to 20. For example, for every 100 million vehicle kilometres travelled in Canada during 1982, there were approximately 2 fatal accidents and 2.3 fatalities; about 86 injury accidents and 123 injuries; and 280 property damage accidents (1979). When expressed in terms of licenced drivers, were about 29 fatalities and 1,600 injuries per 100,000, as shown in Figures 21 and 22.

These figures, combined with health statistics indicating that approximately one of one hundred persons are injured (the majority not seriously) and approximately one in 5,900 persons die each year in traffic accidents, suggest the complexities entailed in dealing with the problem. On the one hand, the problem of traffic accidents seems very substantial--the leading cause of death among persons under thirty-five years of age and a major contributor to inefficient use of finite societal resources (over an estimated \$2.5 billion in costs). On the other hand, the system within which these costs occur can be considered as highly cost-beneficial, as few individuals have advocated dismantling

FIGURE 16

FATAL ACCIDENTS PER 100 MILLION VEHICLE KILOMETERS TRAVELLED

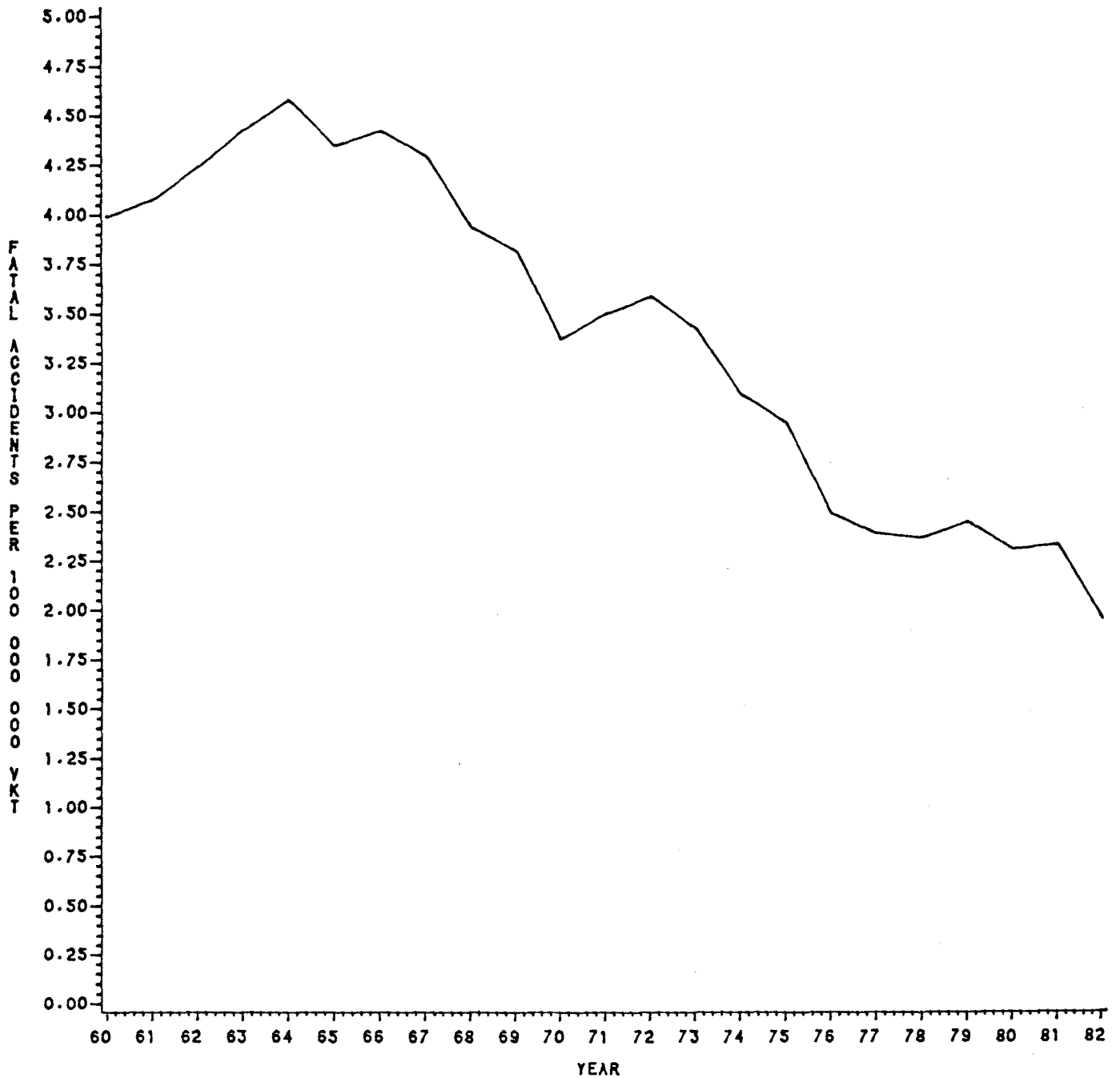


FIGURE 17

INJURY ACCIDENTS PER 100 MILLION VEHICLE KILOMETERS TRAVELLED

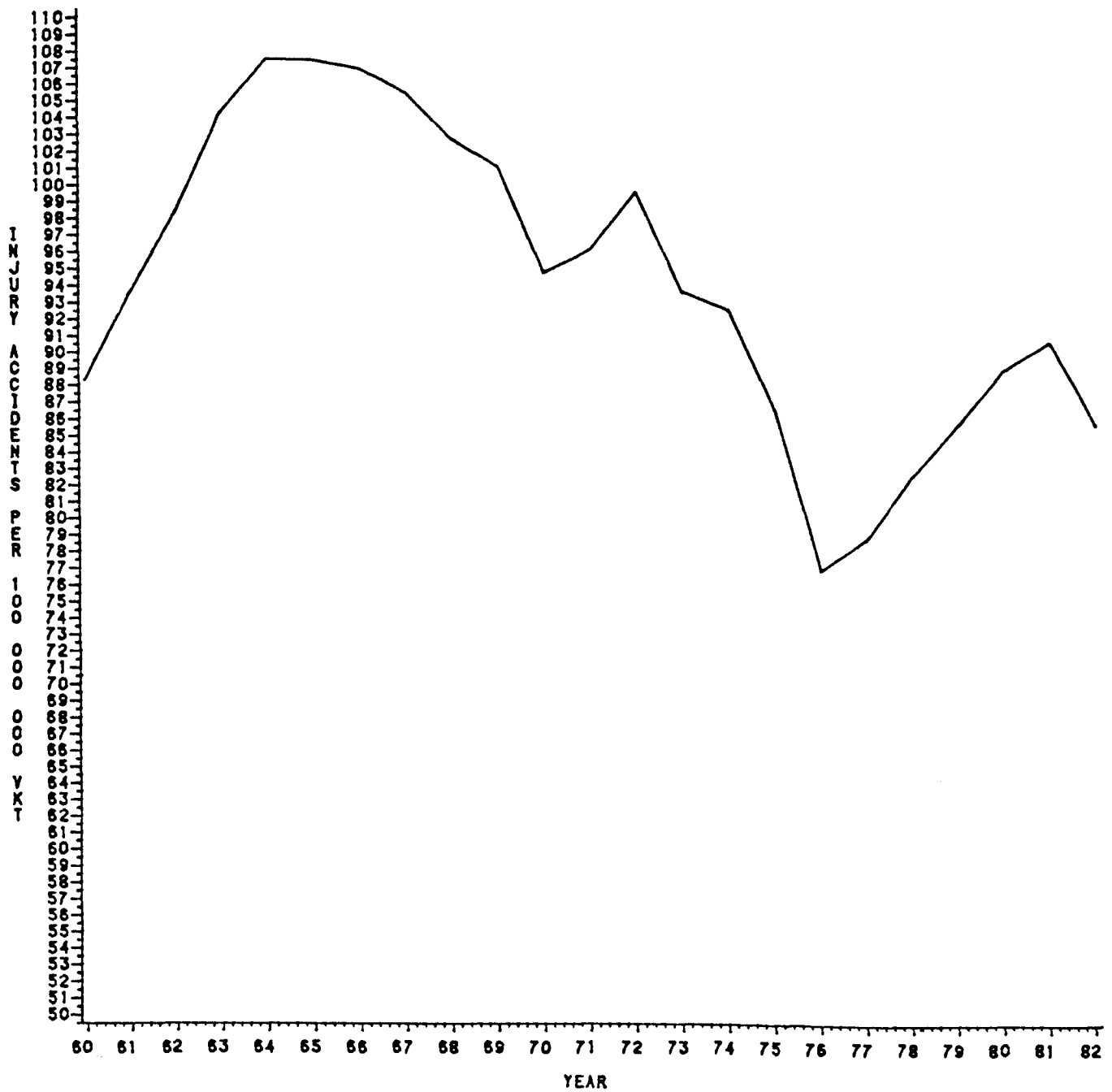


FIGURE 18

PROPERTY DAMAGE ACCIDENTS PER 100 MILLION VEHICLE KILOMETERS TRAVELLED

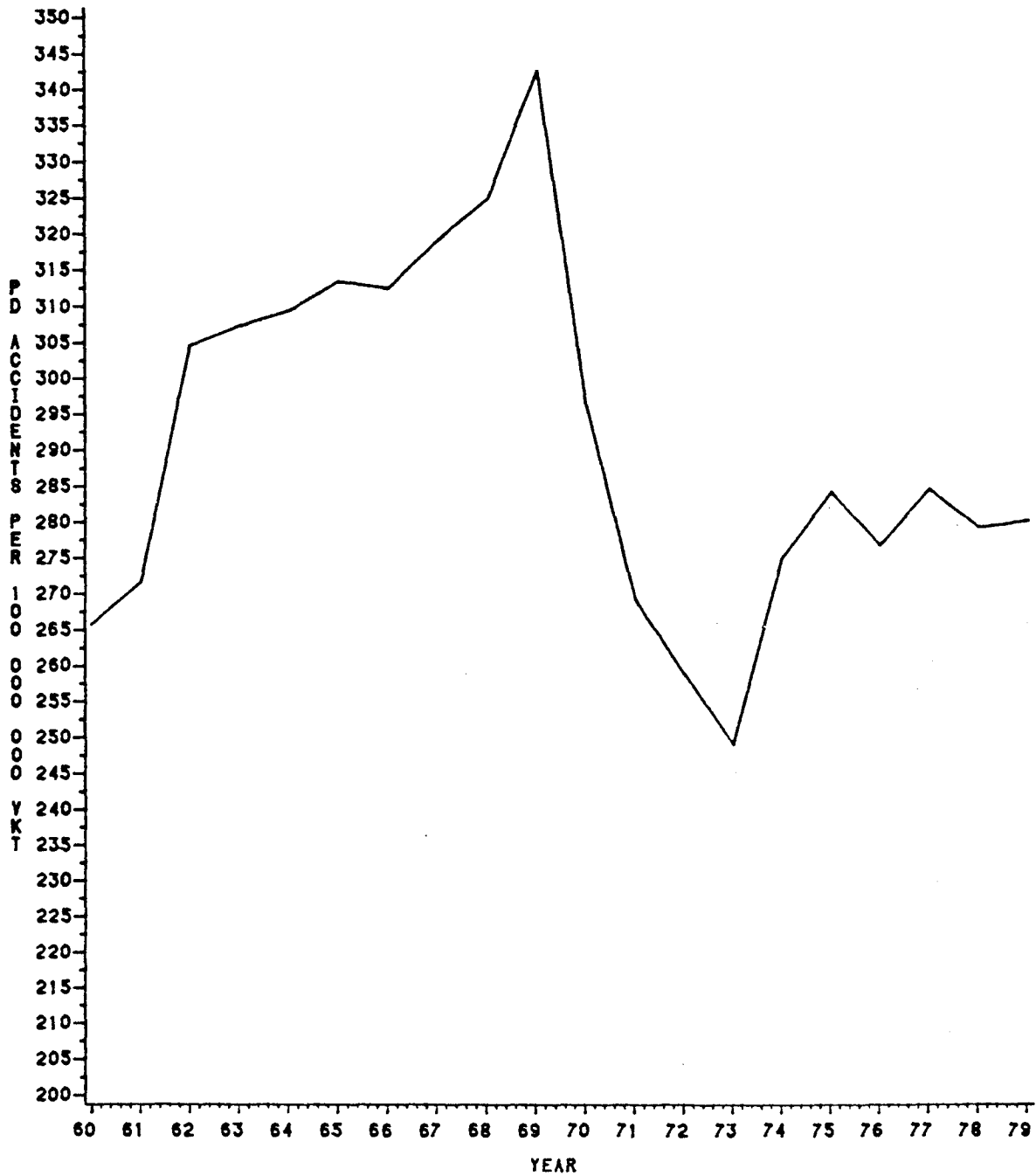


FIGURE 19
FATALITIES PER 100 MILLION VEHICLE KILOMETERS TRAVELLED

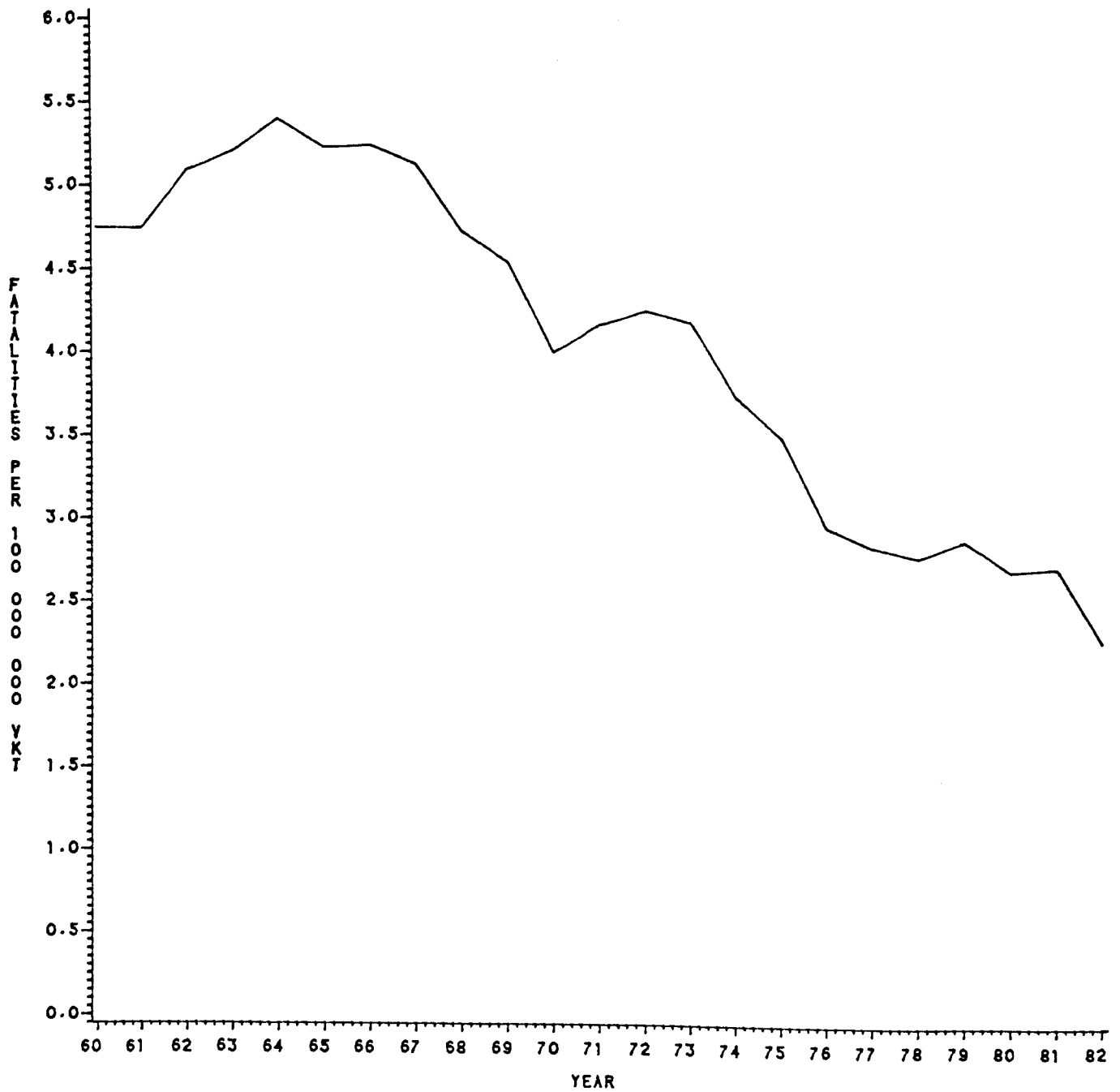


FIGURE 20

INJURIES PER 100 MILLION VEHICLE KILOMETERS TRAVELLED

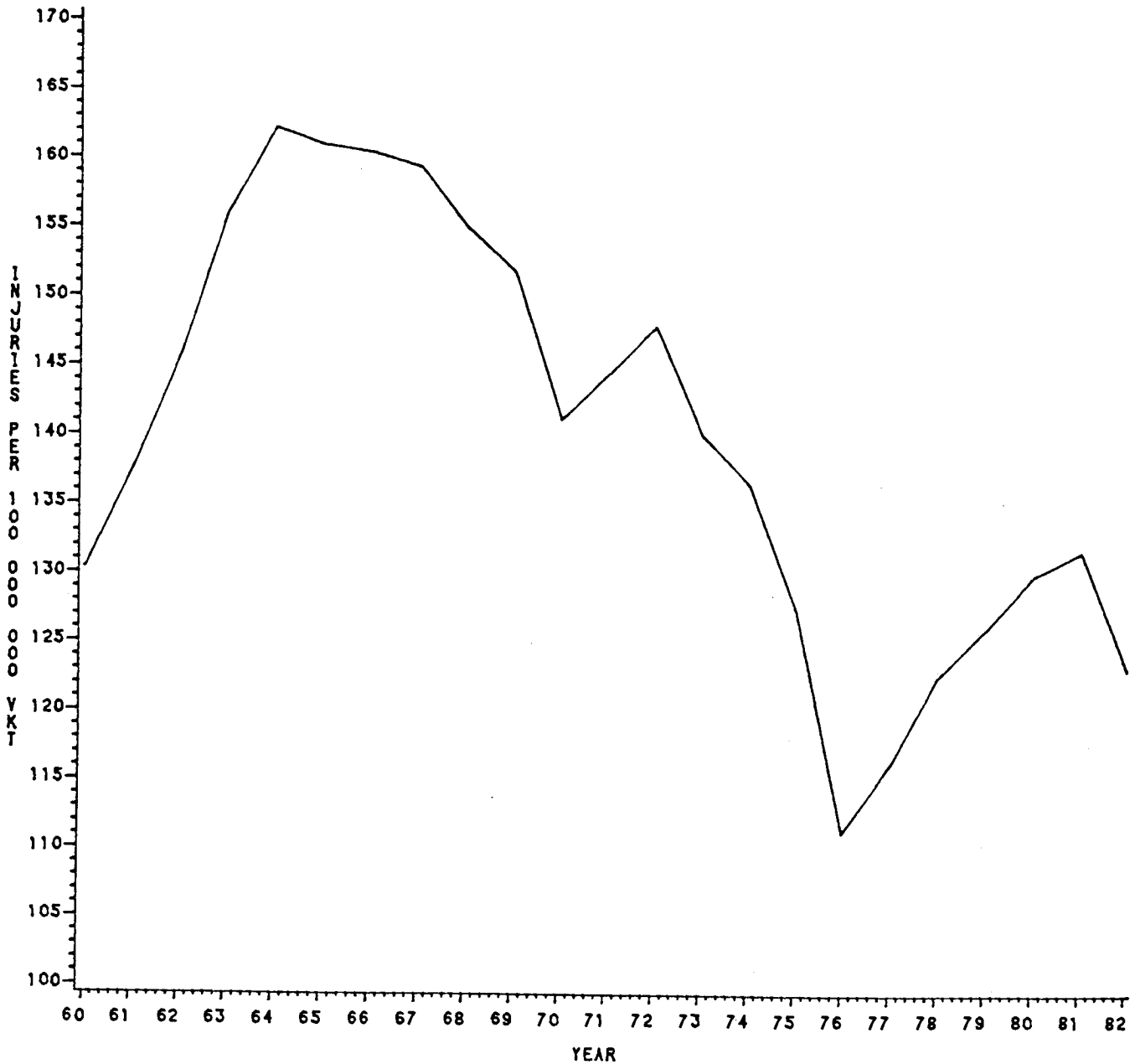


FIGURE 21

FATALITIES PER 100,000 LICENCED DRIVERS

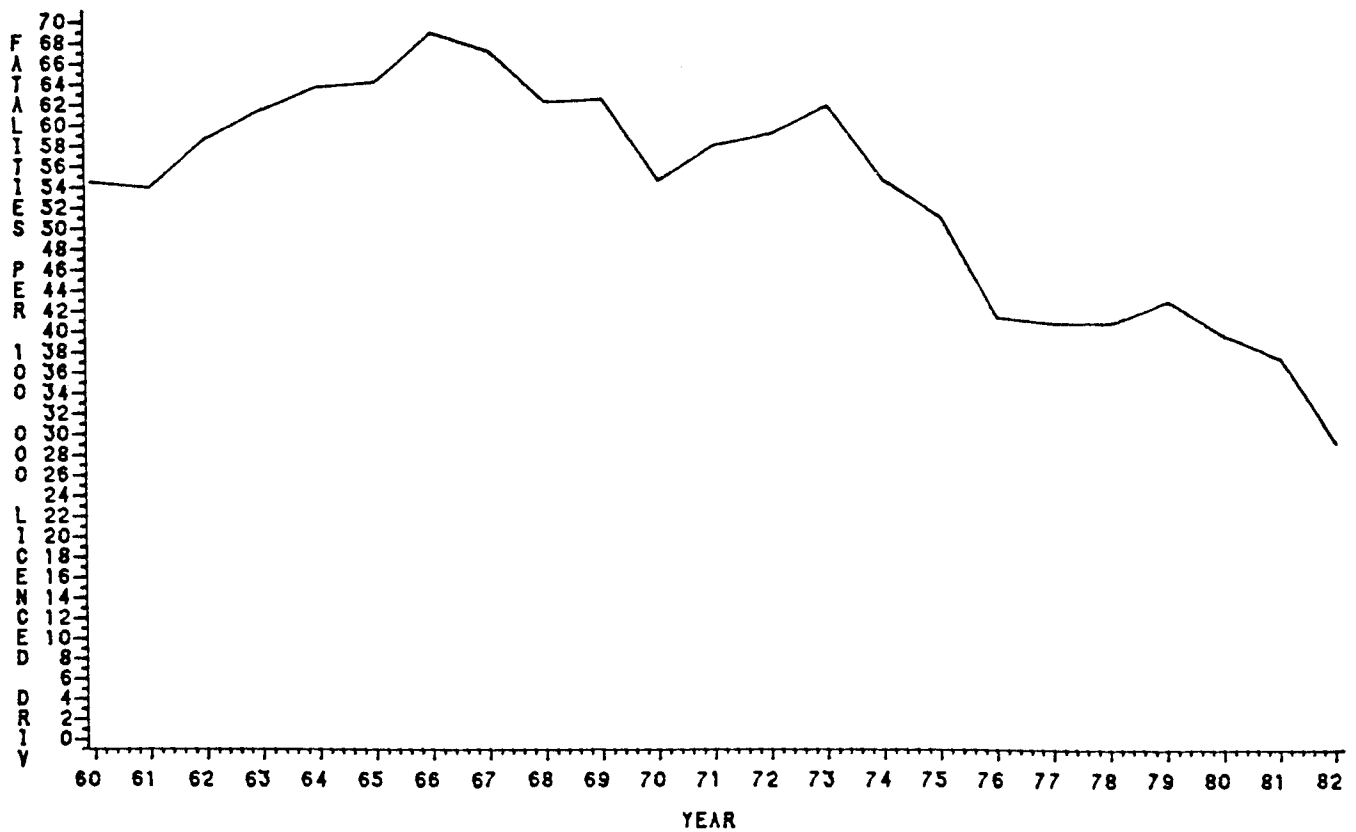
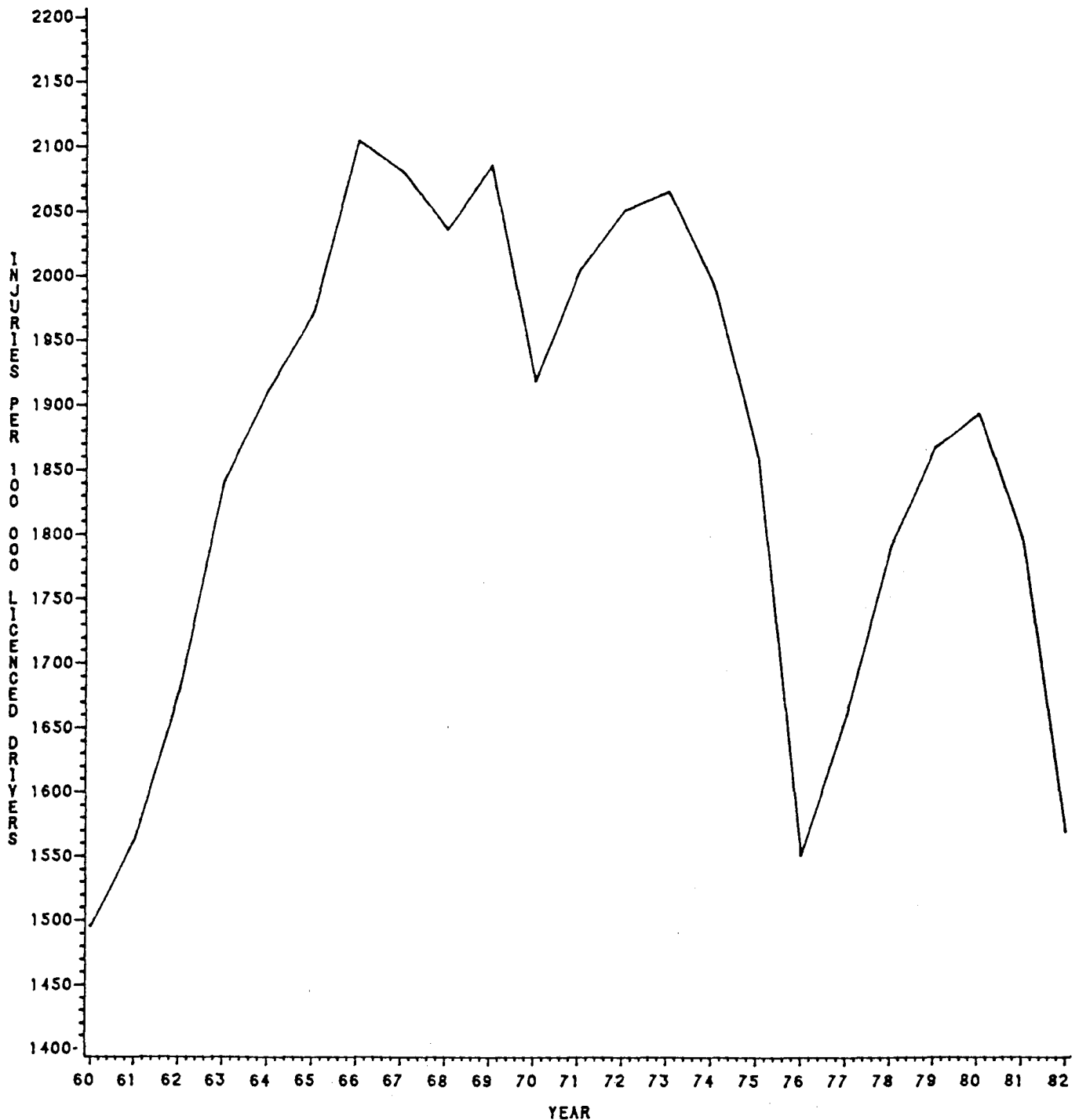


FIGURE 22

INJURIES PER 100,000 LICENCED DRIVERS



the existing transportation system as an accident countermeasure (Whitlock 1971; Whitelogg 1981). Although the numbers of casualties have tended to increase (and casualty rates per 100,000 population remain largely constant) indicators of system efficiency such as collisions per 100,000 drivers, or collisions per 100 million VKT imply that the system is increasingly safer. As (serious) collisions become more frequent (in number), they simultaneously become less likely (per driving occasion) (Haight 1980). This gives rise to a seemingly paradoxical situation: As the system becomes progressively safer, the magnitude of the health problem posed by the existence of the system becomes progressively worse and more costly.

2.2.3. Summary. Motor vehicle transportation in Canada is an integral feature of our modern industrial society. It plays an essential role in economic and social affairs. Its ubiquitous presence and our strong reliance on it is reflected in massive investments, for example, highway expenditures; motor vehicle manufacturing, sales, and use; and in the large proportion of Canadians who are licenced as motor vehicle operators.

From the perspective of transportation safety, even though the numbers of road accidents, deaths, and injuries seem large, relative to the use of the road transportation system, the road accident problem becomes small. Rates, not numbers, tell a story of steadily improving safety. The benefits of the system in supporting growth and mobility are tremendous. Yet, the magnitude of costs associated with road accidents, particularly health care costs, are also very great. From the perspective of public health, road trauma ranks high as a concern. As a social issue, however, prevention of road trauma in general ranks low relative to others, such as economic conditions, unemployment, environmental quality, etc. Perhaps one reason is the nature of the problem of road accidents itself. Road accidents affect relatively few people in any given period of time. Then, for many, the experience seems "acute", "unlucky", and, however unpleasant and inconvenient, the event passes into memory and life goes on. Other problems appear chronic, constantly touching the lives of most--inflation, high interest rates, the struggle

to make ends meet. Issues like these may override concern about road accidents, which, though unfortunate and often tragic, almost always happen to someone else. Thus, the nature of the road accident problem--large in aggregate, nearly nonexistent at the level of the individual--contributes to its lower priority in the policy-making sphere and to its receiving a lower proportion of funding for prevention programs than its magnitude would appear to warrant.

Specific issues related to road safety and public health do rise into prominence, of course. Legislation and enforcement programs dealing with mandatory use of seat-belts, child restraints, and motorcycle helmets are examples. Another, the subject of this report, is alcohol and road accidents.

2.3 Alcohol and Road Accidents: Insoluble Problem?

In Canada, as in many other countries that have an "alcohol-crash problem", alcoholic beverages are freely available and affordable. Licencing requirements at present suggest that driving an automobile constitutes more an individual right than a social privilege. Massive, multi-billion dollar industries that now shore up a faltering economy support the status quo. Considering, as we have, the remarkable prevalence of alcohol use and of another, more modern addiction--dependence on the automobile--is it really any wonder that people sometimes combine the two to create an utterly predictable problem? Isn't the alcohol-crash problem, given the social and cultural milieu, inevitable? Isn't this problem, given current social conditions and forces, intractable? Those dedicated to public health and safety can hardly answer in the affirmative.

Nonetheless, when we address drinking-driving problems with the aim of reducing them, we have to keep firmly in mind their potential intransigence. We cannot emphasize enough that, as a source of public concern, alcohol and road accidents represents the amorphous intersection of two complex spheres of human behaviour. The locus of concern--the alcohol-crash problem--is common to those active not only in traffic safety

but also those active in the alcohol abuse field. The widespread use of alcoholic beverages in the driving-age population (or, alternatively, the frequent and necessary use of motor vehicles in the drinking-age population) has posed a dilemma to the related fields of public health and transportation safety: how to separate these ubiquitous, legal, and (in the main) socially accepted activities, thus preventing or reducing the incidence of traffic accidents due to alcohol-impaired driving.

The preceding review suggests several reasons why "simple", effective solutions will likely prove evasive.

First, the use of alcohol among the driving-age population has tended to increase steadily. Although the rate of increase in alcohol use may be levelling off, there is evidence of the progressive integration of alcohol use into an increasingly broad range of activities. As the integration of alcohol use into a broader scope of activities continues (particularly those activities conducted outside the home), the probability that driving will occur after alcohol consumption may increase, even if overall per capita consumption remains relatively stable.

Second, the use of the Canadian transportation system (in particular, private vehicular travel) has increased over time, and, with the exception of recessionary times, will probably continue to increase. Whether the indicator used is vehicle kilometres travelled, number of registered motor vehicles, number of licenced drivers, or proportion of the "eligible" population licenced to drive, it is apparent that system use has increased substantially over the past two decades. As use of the transportation system expands, particularly into the realm of non-essential (e.g., recreational, social, pleasure) use, the probability of driving after drinking appears likely to increase as well.

Third, the considerable integration of both alcohol use and transportation within a common realm of human activity (recreational, social, leisure) suggests that separation may be difficult to achieve. Transportation is an important facilitator of socialization, recreation, and

social interaction; it would appear that alcohol consumption, as well, increasingly is viewed as an important adjunct to many of these activities.

Fourth, significant alcohol-related problems affect only the minority of drinkers directly and arise only on a minute proportion of drinking occasions. In contrast, the vast majority of drinking occasions are associated with pleasurable and desirable outcomes. This has implications for the development of public policy. For example, the relatively low frequency of adverse consequences due to drinking does not lend support to policies that impact strongly on the "plus" side of alcohol consumption in the name of addressing negative outcomes. Moreover, the fact that only a small proportion of alcohol users are "chronic alcohol abusers", coupled with the fact that only a small proportion of drinkers suffers alcohol-related damage (in particular, traffic crashes), creates the (possibly erroneous) impression that the majority of alcohol-related damage is attributable to a small proportion of "irresponsible" chronic, heavy drinkers (Waller and Turkel 1966; Waller 1967; Gusfield 1981; Gerskin 1981). Isolating and "treating" (generically) a small proportion of drinkers or drinking occasions (i.e., those most responsible for damage), without unduly "inconveniencing" or punishing the vast majority of alcohol users (those not responsible for damage) presents an extremely difficult task, given inherent legal, social, and political constraints.

Similarly, although the transportation system may contribute substantially to public health problems, serious accidents remain rare events, afflicting only a small minority of the population, with an extremely low probability of occurring per driving occasion. (To provide a crude indication of the actual probability, if an "average driving trip" is defined as 16 kilometres, then the fatality rate in 1982 was about one death per 2.6 million driving trips. (Similarly, the fatal accident rate was about one in three million driving trips.) Once again the problem of identifying, isolating, and "treating" the small minority of drivers, driving trips or behaviours (those most responsible for damage) without unduly "inconveniencing" or unjustifiably punishing the vast majority is a complex and arduous task. This, along with the seemingly

paradoxical, inverse correlation between the number of transportation-related deaths and injuries and the rate of casualties per VKT, suggests the difficulties entailed in making meaningful inroads. Indeed, several safety experts have argued that each further, incremental improvement in safety (reduction in death rate per VKT) is likely to prove increasingly costly (Baker 1973; Haight 1980). In fact, the road transportation system in Canada is among the safest in the world (Smeed and Jeffcoate 1970), and it may be argued that the associated costs of road accidents are simply the price society pays for doing business. Given the potentially great costs of further reducing losses from alcohol use, transportation, or a combination of the two, it is equally tempting to conclude that the problems are intractable, and societal resources would be directed more profitably elsewhere. Again, perhaps only those dedicated to public health and safety would fail to concur.

In addition, several existing conditions seem likely to inhibit progress in the field of traffic safety and alcohol-related damage. Some sectors of society encourage drinking as an adjunct to daily living and promote the purchase and use of automobiles as a preferred mode of transportation. Other sectors discourage both drinking and driving. This "social schizophrenia" is reflected in the public media, and it manifests most acutely in government. Some departments collect vast amounts of needed revenue derived from taxes and licencing fees, and even subsidize the manufacture and distribution of alcohol and motor vehicles. Other departments (usually health and safety agencies) exist to manage the consequences of misuse of these products and to prevent further misuse. The alcohol-crash problem may have logical solutions, but can all the disparate elements of society ever be persuaded to accept them?

Primary responsibility for resolving the dilemma of alcohol and road accidents has resided in the traffic safety community. Until recently, public health agencies have played a considerably less active role in reducing alcohol-crash losses. Health and safety interests draw much support and substantial resources from the education, criminal justice, and health care systems, as well as other governmental agencies such as motor vehicle and driver licencing agencies. The scope and practice of

alcohol and traffic safety, therefore, is as broad as the alcohol-crash problem is diffuse. In not accepting that this problem is inevitable and intractable, the health and safety community as a whole must reassess its strategies and priorities. The alcohol-traffic safety experience has at least one lesson to offer--the alcohol-crash problem will not disappear on its own.

3.0 THE MAGNITUDE AND CHARACTERISTICS OF THE PROBLEM

This section concerns the relationship of alcohol use among road users and the occurrence of road accidents. Emphasizing the Canadian experience, it summarizes present knowledge about the nature and magnitude of the alcohol-crash problem. In doing so, the following general issue is raised:

- o Has research, for all practical purposes, adequately defined the magnitude and extent of the alcohol-crash problem, its nature and characteristics? If not, what specific information is still required in order to deal more effectively with the alcohol-crash problem?

The next section provides a brief overview of research conducted in the area of traffic safety. In subsequent sections, four topics receive more detailed consideration:

- o Alcohol and the Ability to Drive Safely.
- o Alcohol and the Risk of Road Accidents.
- o Alcohol and Road Accidents in Canada.
- o Drivers Who Drink/Drinkers Who Drive.

3.1 Background

The scientific study of alcohol and road accidents began over fifty years ago and continues still today. In general, this activity has never evidenced the systematic, methodical inquiry characteristic of other scientific endeavors. One explanation is that research per se often has formed the backdrop for programs aimed at reducing a suspected though ill-defined alcohol-crash problem.

This activity provided objective evidence to help gain support in the fight against this basic accident cause. Since drinking of alcoholic beverages does not generally carry a serious social stigma, an unspoken "drinking partnership" was recognized to exist between a large segment of the public and the drinking-driver defendant.

This affinity often results in less-than-energetic prosecution of this conduct that is dangerous from the traffic safety standpoint. Thus, one of the basic reasons for the extensive research efforts has been to attempt to dramatize the enormity of the problem and the seriousness of its effects on a complex and fast-moving society. (Borkenstein et al. 1963, p.144, emphasis added)

Early studies demonstrated what many already believed as true, namely:

- o that alcohol can impair skills related to driving;
- o that increasing amounts of alcohol produce greater impairment; and,
- o that drivers impaired by alcohol were more likely to have road accidents than their nondrinking counterparts.

Subsequently, refined and more rigorous methods have allowed study of how alcohol affects driving performance, how often alcohol-involved traffic accidents occur, and how little alcohol in the body impairs driving skills. By the end of the 1960's, as large-scale countermeasure programs were put in place in many countries, research had demonstrated a strong association between alcohol use among road users and road accidents, especially fatal accidents. Although the statement that "alcohol causes accidents" remains unproven in the strict scientific sense, the public did not doubt its causal role and supported both the enactment of unprecedented laws, as well as the large expenditure of funds for drinking-driving countermeasures.

Conceptually, "defining the problem of alcohol and road accidents" involves a process of discovery and requires a certain structuring of research efforts. Even to summarize what is known about alcohol use by road users and the outcomes of drinking-driving behaviour, we have to impose order on the hodgepodge of studies reported in the literature. Heise (1934) first outlined basic approaches to the scientific study of the problem. These included (1) the experimental study of alcohol's effects on skills related to actual driving; (2) the epidemiologic study of alcohol use among various populations of drivers; and (3) the measurement of the amount of alcohol in the body. The third "approach"

actually was a means to gather objective data on the presence and amount of alcohol for both experimentation and epidemiology. Reviewers of research since that time have employed outlines based on this conceptual framework.

Experimentation and epidemiology are the main categories of research to define drinking-driving problems. As discussed elsewhere (Perrine 1976; Joscelyn et al. 1981a; Simpson and Warren 1981), these approaches are distinct and complementary. Each has limitations arising from practical, legal, ethical, and theoretical constraints. Together, however, they provide an adequate basis for describing the nature and magnitude of drinking-driving problems. (See Donelson and Beirness [1984] for a detailed discussion of this topic.)

For example, experimental studies to prove that alcohol impairs the ability to drive in "real-life" situations are not feasible, given ethical--and legal--considerations. Studies in the laboratory or on closed driving courses, however, also have inherent drawbacks. The virtues of controlled experimentation become a mixed blessing when one wishes to generalize findings to practical questions (Chapanis 1967). Nonetheless, although experimental studies of alcohol's effects do not predict actual driving impairment, they are indispensable for investigating how and how much alcohol affects measures of driving performance.

The role of epidemiologic research has been (1) to establish the degree and nature of the association between alcohol and road accidents; and (2) to identify other factors that, along with alcohol, may increase the risk of accident involvement. The methods of epidemiology can establish accident risk but, unlike the well-controlled experiment, cannot prove that alcohol "caused" all accidents in which it was found present. In fact, for the study of nonacute disease and noninfectious conditions in general, the classical notion of cause, which was deterministic, has been replaced by the theory of probability. Probability statements indicate the likelihood, or degree of certainty, about events. They do not assume absolute certainty about their occurrence. Thus,

epidemiologic findings are inherently probabilistic, measuring the degree and directness of association between alcohol and road accidents.

Throughout the long process of problem definition and risk identification, one element of the alcohol and traffic safety experience stands out as essential: blood alcohol concentration (BAC). As a distinct, methodological area of research and development, the chemical analysis of body fluids for the presence and amount of alcohol was critical to the advance of knowledge in alcohol and traffic safety (Borkenstein et al. 1963). The results of pharmacokinetic, biochemical, and physiologic studies greatly supported experimental and epidemiologic efforts to define the problem.

The special chemical and physical properties of ethyl alcohol permitted its simple detection and quantitation in body fluids. Its behaviour and reactions in the body were found to be relatively simple and predictable. Most importantly, the amount of alcohol in body fluids correlated well (on average) with the magnitude of its effects. Technology provided the means to estimate BAC with ease and accuracy in the breath of experimental subjects, survey respondents, and persons suspected of driving while impaired. BAC measurements quickly became the vital link between experimentation and epidemiology and one of the cornerstones of legal countermeasures.

The following sections summarize the present state of knowledge about alcohol and road accidents. Many comprehensive reviews have been published, some recently (e.g., Jones and Joscelyn 1979a,b; OECD 1978; Edelman et al. 1977; Warren and Simpson 1978; U.S. Government Accounting Office 1979; Law Reform Commission [Australia] 1977; Perrine 1974). No attempt is made here to duplicate these efforts. Rather, the purpose of the sections below is to highlight major findings of experimental and epidemiologic research and to identify issues that may warrant some consideration.

3.2 Alcohol and the Ability to Drive Safely

What is alcohol-impaired driving? Early opinions lacked scientific validity, but the question was raised, and by 1914 experimentation to answer it had commenced in Sweden, conducted by Widmark. Widmark first combined established methods for testing neurological disorders and determining the presence and amount of alcohol in body fluids to define the "alcoholic influence syndrome".

During this same period, in the United States, Heise was examining drivers suspected of operating under the influence of alcohol for the Pennsylvania State Police. At first his examinations were based on physical tests and observations without chemical tests for alcohol. Bitter courtroom experience rapidly taught the need for showing the cause for abnormal behavior. He turned to the work being conducted in Sweden by Widmark. Thus, the Widmark philosophy was brought to the United States.

As a result of this chain of events, the pattern of the approach to the problem was quite firmly established, comprising a battery of psychophysical tests to demonstrate impairment, coupled with a chemical test to show the presence of alcohol as the cause. This form remains substantially the same today. (Borkenstein et al. 1963, p. 140.)

Early research correlating the effects of alcohol with its concentration in blood and urine soon found application. In this regard, the National Safety Council Committee on Tests for Intoxication proved a potent force in the area of alcohol and traffic safety, even though "its role has been limited to developing recommendations for its control, including legislation, enforcement, education, chemical testing equipment, training of testing personnel, and other aspects of alcohol countermeasure programs" (National Safety Council 1978, p. 1). Among its more important contributions were standards interpreting the significance of blood alcohol concentrations, and thus defining the vague legal phase "under the influence of alcohol":

- o less than 0.05% w/v, no influence of alcohol within the meaning of the law;
- o between 0.05% and 0.15% w/v, alcoholic influence usually present, but courts of law should consider

driver behaviour and circumstances leading to arrest;

- o 0.15% w/v and greater, definite evidence (prima facie evidence) of "under the influence".

However, these standards, which lawmakers incorporated into statutes prohibiting driving under the influence of alcohol, derived from laboratory tests that bore little relation to actual driving.

In the decades that followed, a remarkable number of studies have been conducted on the effects of alcohol, although their cumulative value in advancing knowledge in alcohol and traffic safety has been less than might be thought (Carpenter 1963; Levine, Greenbaum, and Notkin 1973; Perrine 1974). A wide range of behavioural and other effects of alcohol were reported (e.g., Wallgren and Barry 1970), but their comparability is poor and their relevance to the impairment of driving ability per se is uncertain. Obvious limitations of many laboratory tests has led to an emphasis on techniques and methods with greater face-validity, for example, driving simulators and vehicle-based tests, such as closed driving course tests.

In reviewing the experimental literature, Jones and Joscelyn (1979a) concluded:

Simulator studies of behavior thought to be related to driving have shown highly conflicting results, but seem to indicate that one's ability to perform complex tasks is more impaired by alcohol than for simpler tasks. The relationship between simulator tasks and street driving has been seriously questioned in the literature.

Closed course driving experiments indicate that the ability of many drivers to perform parking maneuvers becomes impaired at low BACs (i.e., .04% to .06% w/v). Closed course driving performance at low speeds appears to be degraded for average drinkers at BACs of .08% to .10% w/v, but less so for heavy drinkers. Closed course driving performance at moderate speeds has been shown to be impaired at BACs as low as .05% to .07% w/v.

Thus, there is evidence that some behaviour that appears to be related to driving performance is impaired by alcohol. The exact nature and extent of these

impairments and their frequency of occurrence among different individuals at given BACs cannot be stated. Lacking explicit relationships between the behavior studied and critical driving tasks, it cannot be said precisely how these impairments affect one's probability to being involved in a crash. What emerges, however, is the behavior that has been studied is consistently and significantly impaired in virtually all individuals as BACs approach .10% w/v. Many persons, particularly lighter drinkers, have shown impairment at much lower BACs. Only a relatively few of the heaviest drinkers appear to suffer little impairment at BACs much greater than .10% w/v. (p. 49)

Experimentation in alcohol and traffic safety, such as that described above, indicated that the presumptive BAC standard for "under the influence" (0.15% w/v in many jurisdictions) had been set too high. The influence of alcohol on driving skills included amounts of the drug well below those associated with drunkenness or intoxication. Laws in many countries were revised based on this knowledge, and lower BAC values were adopted (e.g., .05%, .08%, and .10% w/v).

Experimental research has demonstrated conclusively that alcohol can impair performance of skills and tasks related to, or at least resembling, actual driving. But has it--can it--demonstrate beyond a reasonable doubt that alcohol at concentrations below those that produce obvious driving problems impairs the ability to drive safely? Does any degree of influence by alcohol translate into an inability to drive safely?

Some skills used in driving are affected by concentrations of alcohol as low as .03% w/v, about a couple of drinks. One Canadian study employed an instrumented car with a computer-based data acquisition system. It showed that differences in the performance of three tasks (velocity maintenance, car-following, and stopping) at 0.03 and 0.063% w/v BAC (mean) can be discriminated reliably by use of multivariate--but not univariate--analyses, as noted by the authors (Attwood et al. 1980):

This experience suggests that performance of typical driving tasks under sober conditions can be differentiated from performance under moderate levels of

intoxication using multivariate techniques that assume a linear relationship between performance and intoxication. The results also indicate that intoxicated drivers can be correctly identified using multivariate weighting functions. Extending these findings, it should be possible to classify consistently a driver as sober or intoxicated by comparing his current driving performance with his past performance under known levels of intoxication. If this hypothesis is confirmed by future experimentation, and with the availability of on-line detection and computation systems, the development of an interlock that is based on the continuous monitoring of driving performance should be feasible. (p. 63)

It should be noted that the intent of this study was to develop a technique to discriminate between "sober" and "intoxicated" drivers. The three tasks employed, in all probability, do relate to the ability to drive safely. The experiment itself, however, focused on the performance of these tasks and did not--nor could not--address a larger issue: whether the performance of these tasks as altered by alcohol indicates impairment of the ability to drive safely, that is, the ability to drive without accident involvement. It should also be noted that, in general, the moderate BACs of the "intoxicated" drivers did not so adversely affect their overall performance as to be noticeable by observers.

Nevertheless, results of experimental studies of alcohol effects on driving skills have been used to justify lower BAC standards for defining alcohol-impaired driving. This use of research findings ignores a fundamental issue in experimental research--generalization to the real-world driving task and the effects of alcohol on the ability to drive safely. As Chapanis (1967, pp. 571-572) observed:

In focusing on statistical significance a laboratory experiment completely ignores the problem of practical significance. It is a curious paradox: the more successfully a laboratory scientist increases the precision of his experiment, the more likely it is that he will prove statistical significance for effects that are practically trivial. This is, none the less, one of the major difficulties we face when we try to generalize from laboratory experiments to the solution of practical problems. The results of a laboratory experiment may tell us that we are dealing with a statistically

significant effect, but they never tell us whether the effect is practically important or unimportant.

Undoubtedly, the effects of moderate amounts of alcohol result in statistically significant decreases in precise measures of human performance. But experimental studies of alcohol's effects have evidenced a certain value-loading, or bias, in their design and conduct. Often, demonstration of impairment or skills reduction appears the purpose of experimentation. With increasingly refined techniques, decreases in performance measures can be found at even lower BACs. The practical meaning of such findings appear to decrease as well. "Impairment" here may not equate with "unsafe" in the larger context.

This issue--relating the effects of alcohol on driving-related skills to impairment of the ability to drive--has its greatest relevance in setting, or resetting statutory BAC limits. Donelson and Beirness (1984) discussed the issue at length, examining the extent to which experimental data supported changing the present limit in the Canadian Criminal Code from .08% to .05% w/v. They concluded that available evidence did not strongly support such a change, given that many persons with BACs between .05% and .08% w/v are not so affected as to constitute impairment of the ability to drive.

Moreover, persons with BACs in lower ranges above the legal limit (e.g., .08% to .12% w/v BAC) seldom come to the attention of enforcement officers unless they commit another violation, such as equipment or traffic offences (Zelhart and Schurr 1977). The average BACs of persons arrested for alcohol offences in Ontario in 1969 and 1970 (before and after the introduction of the .08% w/v per se law) was .20% w/v (Inter-ministerial Committee on Drinking and Driving 1974). Impairment of actual driving performance is not obvious to the casual observer until high BAC values are reached (Rockerbie 1979). To identify persons with illegal BACs less than .15% w/v, enforcement officials have had to rely increasingly on technology (for example, roadside breathtesting equipment), subtle behavioural indices (for example, nystagmus), or more invasive tactics (for example, the roadside stop procedure conducted at random). These methods have allowed police to identify and arrest

persons having lower illegal BACs even though a driver may have exhibited no reckless or unusual deviations from norms of driving behavior, nor any obvious impairment due to alcohol. The present law that prohibits driving with a BAC at .08% w/v or greater can be perceived, therefore, as excessively penalizing drinking drivers who are otherwise driving safely and who do not show impairment.

The credibility of the per se law is also at issue. That many people continue to drive with BACs exceeding the legal limit has been established through roadside surveys (see following sections). Many drivers who know the law choose to disregard it. Why they disregard it has not been the focus of much research. One can speculate, however, that they may understand how alcohol affects their driving capability and still believe that their ability to drive safely has not been impaired. Although the traffic safety community may not wish to dwell on it, the fact remains "that the overwhelming majority of drinking drivers do not crash, since figures show that some 20 percent of drivers on the road at night in North America have been drinking" (Simpson and Warren 1981, p. 190). This statistical fact may be reflected at the individual level in a drinking driver's experience. Such drivers, after many successful trips, may well feel victimized by police at a random roadside checkstop. Far from feeling guilty of a crime, they may at best chalk up their arrest to the "luck of the draw", or, at worst, feel bitterly resentful of the system and the law (Gusfield 1981).

Thus, there may exist substantial differences between the threshold of skill impairment as measured in a laboratory, and the point at which the ability to drive safely is noticeably, even measurably, compromised by alcohol. At the root of this disparity is the fact that the driving task is poorly defined--and poorly approximated by most experimental methods (see Donelson and Beirness [1984], pp. 5-16). As Jones and Joscelyn (1979a) stated, "Lacking explicit relationships between the behavior studies and critical driving tasks, it cannot be said precisely how these impairments affect one's probability of being involved in a crash" (p.49). Yet, present laws incorporate BAC standards believed consistent with experimental research focused on alcohol impairment, not

on alcohol's effect on the ability to drive safely. Safe driving skills such as perception of real hazard, ability to compensate for moderate alcohol impairment, and the ability to maintain an adequate safety margin--identified in the theoretical literature on driving (e.g., Naatanen and Summala 1976)--have not been researched in any depth at all, perhaps for fear that findings would lead to misunderstanding by the public. Research has not been conducted to measure the ability of persons with moderate BACs, in spite of alcohol's impairment of some skills, to perform tasks related to driving adequately and safely. Experimental studies of this sort would be asking a crucial question, given present knowledge: Why do most drivers impaired by alcohol not have road accidents?

Unfortunately, the emphasis on establishing and justifying statutory BAC limits has detracted from the study of variability in human response to alcohol consumption. In addition, the emphasis on driving skills to the exclusion of alcohol's effects on attitudes toward safe driving and risk-taking leaves large gaps in present knowledge. Yet, paradoxically, this is an area well suited to experimental inquiry. For example, few studies have selection criterion that have been determined from, and are consistent with, the characteristics of individuals who drive while impaired. Experimental studies using the best available methods should be conducted with subjects drawn from the population of convicted DWI offenders. Such research would provide important insights not possible at present.

Similarly, experimental research on the behavioural effects of alcohol is sadly lacking for "high risk" groups of drinking drivers, particularly the young (Warren 1976a); infrequent drinkers (Allsop 1966); "alcoholic" drivers (Smart 1965); and those lacking in driving experience (Warren 1976a). Little experimental research has been conducted upon the effects of alcohol on skills required for the safe operation of special classes of vehicles (e.g., tractor trailers, motorcycles, snowmobiles, etc.). Even sex differences are not documented adequately in the literature, despite the dramatic differences in the collision experiences of men and women drivers (Warren and Simpson 1982). As well, few experimental studies have attempted to document variability in

alcohol-related responses among "risk-taking" and "risk-averse" subpopulations, although the former seems much more characteristic of collision-involved drivers than do the latter.

In sum, it would appear that (in the absence of methods better approximating the driving task) further experimental research justifying present statutory BAC limits is likely to contribute little. There does remain much to be researched experimentally in terms of individual variations in response to alcohol consumption. Further experimentation must focus much more explicitly on specific characteristics of high-risk groups as identified in the epidemiologic literature. Such research must be viewed as a crucial adjunct to better understanding of the drinking-driver problem, and as a vital prerequisite to the establishment of more refined and more cost-effective control measures than exist (or are possible) at present.

3.3 Alcohol and the Risk of Road Accidents

Closely related to the question of alcohol and the ability to drive safely is the issue of alcohol and the risk of road accident involvement.

In order to demonstrate that alcohol in and of itself increases accident risk, researchers employed epidemiologic methods first used in the study and control of infectious disease. In particular, case-contrast (or case-control) studies have compared accident- and nonaccident-involved drivers and pedestrians for their use of alcohol, with as many other relevant factors controlled as deemed needful or feasible (e.g., time of day, day of week, and place of prior accident; age, sex of subject, etc.). This comparison is critical. Although alcohol may be strongly associated with certain types of accidents, no statement about alcohol's influence on the risk of crash-involvement can be made without comparing accident with at-risk populations. Among the more rigorous of formulations, the results of these surveys have been expressed as the relative probability of accident involvement as a function of BAC (Hurst 1970, 1974; Donelson et al. 1980; Donelson and Beirness 1984, pp. 16-22, 44-51).

Figure 23 illustrates the relationship found between BAC and the relative probability of involvement in fatal and nonfatal traffic accidents. As legal limits are exceeded, the risk of being involved in a traffic accident increases relative to the (unknown) risk associated with the zero BAC level. As reviewed by Hurst (1974), this general relationship has limitations in regard to inferences about the influence of alcohol on the ability to drive safely, even when combined with experimental data:

... We have on the one hand laboratory data which may be partially irrelevant and on the other hand field data which do not reveal individual difference distributions except in the gross sense of differentiating demographical sub-groups. As a last resort, we can "combine" the field and laboratory results and draw some tentative inferences. Since the laboratory studies usually show continuous or quasi-normal distributions of individual impairment levels, we may infer that a substantial rise in crash incidence at a given BAC, from field data, is the result of a fairly large number of individual impairments, with everyone else being unaffected. This introduces some iffy propositions, however, and seems inadequate to answer the question of just what percent of a population drives less safely at a given BAC. It is even further from determining the BAC at which a particular individual may rationally be presumed to drive less safely, or presumed not to drive less safely. I would question the basis of laws that set levels for "presumed to be impaired" or "presumed not impaired". (p. 131)

Identifiable subgroups within the population of drinking drivers may have differing relative probabilities of crash-involvement at given BACs. For example, the average driver who reports drinking daily has about the same relative probability of crash involvement at .09% w/v as the average driver who does not drink at all (Hurst 1974) (Figure 24).

In addition to the presence of alcohol and the frequency and quantity of its use, accident and nonaccident-involved drivers have been compared with respect to such other variables as age, sex, estimated annual mileage driven, education, race or nationality, marital status, and occupation. The large-scale controlled study conducted by Borkenstein et al. (1964) permitted an assessment of the increased (or decreased) accident risk associated with these factors. Controlling for these

FIGURE 23

RELATIVE RISK OF CRASH AS A FUNCTION OF BAC

Source: Mayhew 1983

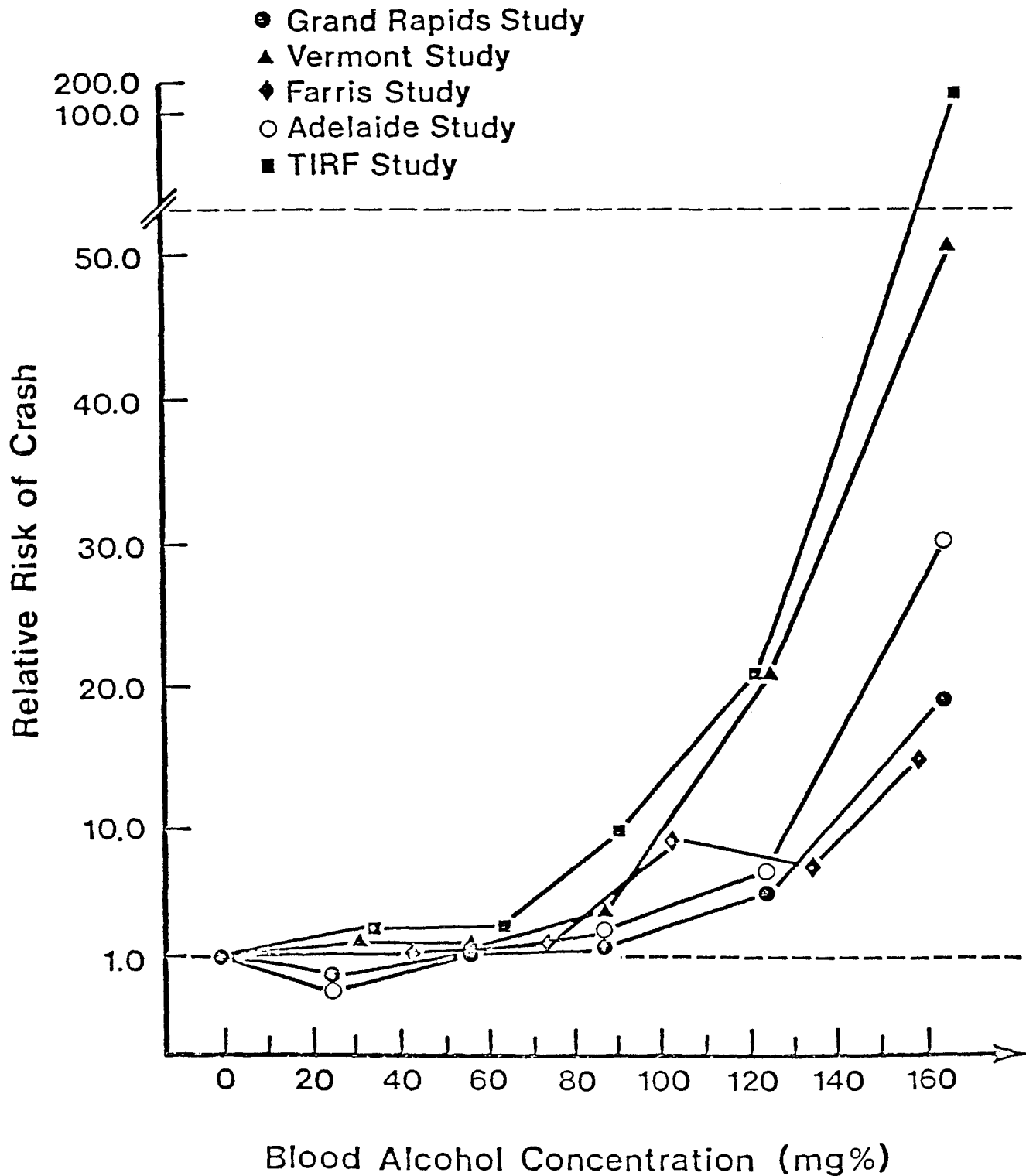
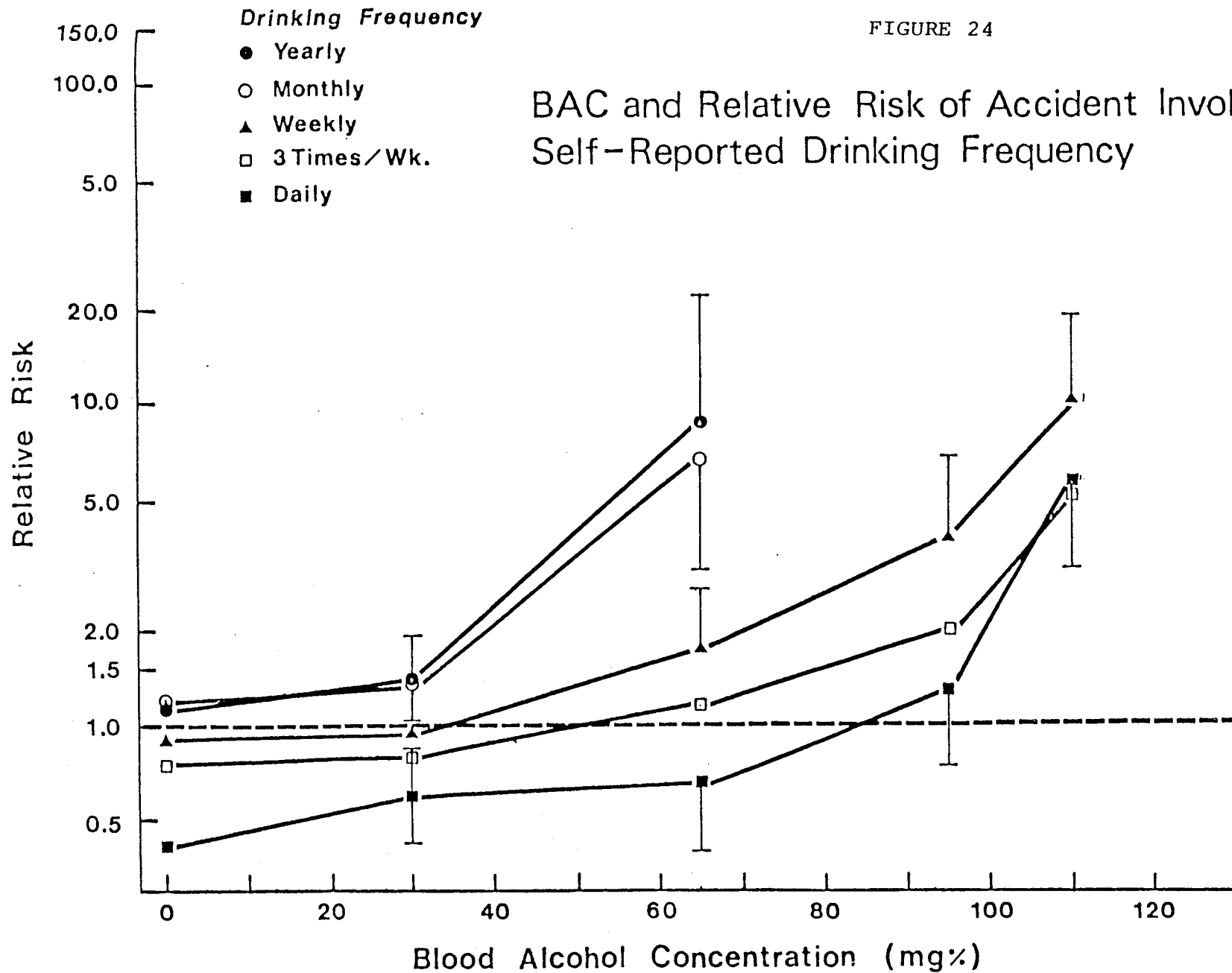


FIGURE 24



Source: Borkenstein et al - 1964; Donelson and Beirness-1984

factors, alcohol use resulting in higher BACs emerged as the dominant, explanatory variable for increased accident risk.

Factors other than alcohol are associated with individual accident experience. In general, the classes with the worst accident experience were those that we anticipated. The frequency with which the young, the very old, the inexperienced, and the uneducated were involved in accidents was out of proportion to their exposure to traffic. At the same time, the identifiers of the safest groups seemed entirely logical. The most highly educated, those with the best employment and the middle-aged have the best records of low accident involvement.

Since many other factors other than alcohol are involved in accident experience, further control was necessary. Tests of the data again showed that within all of the sub-classes of the major factors, the accident rate mounted as the blood alcohol level rose. Then, just as in the preceding analyses, we found that above 0.08 percent blood alcohol level, factors other than alcohol became less and less significant and eventually seemed to disappear. In every case, the higher alcohol levels were associated with more frequent accident experience, and in general, accident involvement increased rapidly as the alcohol levels exceeded 0.05 percent. This association was so strong that other explanations of the excessive accident experience of drivers in the highest alcohol ranges were substantially ruled out. (Borkenstein et al. 1964, p. 6-7)

The final sentence in the above quote may leave the impression that no other factors could explain the increased risk of accident involvement among high-BAC drivers. Clearly, high BACs contribute to increased risk. As discussed later in Section 3.5.3, however, other evidence points to personal characteristics and social circumstances of alcohol-impaired drivers as also contributing to (and thus partly explaining) their more likely involvement in road accidents.

The fact remains, however, that an overwhelming majority of driving trips by persons with high BACs are completed without accident or arrest. Reference to the distinction between "relative risk" and "absolute risk" may help clarify this issue. A statement that a person with a certain BAC has an increased risk of accident involvement compared to the average nondrinking driver refers to relative risk. As

roughly estimated in Section 2.3, the actual probability (or absolute risk) of a fatal road accident is about one in three million driving trips. Drinking drivers whose relative risk is twice that of the average nondrinking driver might have a fatal accident once every one and a half million driving trips (each trip occurring at the BAC associated with a relative risk of 2.0). Drivers with BACs indicating thirty times the risk of the average nondrinking drivers would have a fatal accident once every 100,000 driving trips.

These admittedly crude estimates nonetheless offer statistical support to one expert's comment that the average person could drive drunk around the world and not expect to have a serious road accident. Thus, "increased risk" does not necessarily mean "very likely". Furthermore, we have yet to answer the questions why most drivers with high BACs do not have accidents and how those who do differ from others who do not.

Thus, not unlike the experimental research described earlier, epidemiologic inquiry has focused heavily upon demonstrating that a problem exists and upon the establishment of general (aggregated) relationships between BAC and crash risk. This focus, dictated historically by interest in defining uniform statutory BAC limits for drivers, has tended to detract from the study of response variability. Yet, it is apparent that reduction of data to study the relationship between alcohol and accident risk tends to oversimplify an extremely complex phenomenon. It is apparent that crash risk varies dramatically, not only as a function of BAC, but also as a function of myriad other factors. Fatal crash risk (as a function of BAC) differs across the spectrum of young, middle-aged, and aging drivers; infrequent drinkers and "alcoholic" drivers; drivers of different types and classes of vehicles; inexperienced and experienced drivers, to name but a few. Considerably greater emphasis now must be placed upon documentation of variability rather than uniformity in alcohol-related effects, so that the specificity of countermeasure efforts can be increased. (See Donelson and Beirness [1984, pp. 44-71] for a comprehensive discussion of BAC and the risk of accident involvement.)

3.4 Alcohol and Road Accidents in Canada

Many people, in their first search for statistics on alcohol and road accidents, seem surprised to learn that certain key questions cannot be answered with present knowledge:

- o How many road accidents are due, at least in part, to alcohol impairment?
- o How many victims are killed and injured by alcohol-impaired drivers each year?
- o How many road accidents occur in which the person responsible was alcohol-impaired and had one or more previous convictions for alcohol-impaired driving offences?

The answers to these and others questions are not forthcoming for a variety of reasons. A main reason is that available data are scattered among many sources--coroners, hospitals, police, courts, and traffic accident and driver licencing data systems. The special studies required to gather relevant data from each source are rarely funded and are certainly not done on a provincial or national basis.

In many cases, needed data simply are not obtained. For example, police and medical personnel do not obtain objective data on the presence and amount of alcohol in the vast majority of accident-involved road users. Subjective information included in police accident reports has proven unreliable (Waller 1971). Even when objective data from chemical tests are available, the degree to which the effects of alcohol influenced behavior contributing to the occurrence of a given accident remains problematic. For example, inattention, careless or reckless driving, poor judgment, failure to respond quickly enough in traffic situations--all occur as well in the absence of alcohol. Other physiological and medical conditions (for example, fatigue, mental and physical disease states) are not or cannot be detected; these factors may also contribute to some proportion of traffic accidents in which alcohol is either present or absent. In addition, interpretation of BAC data vis-a-vis impairment (legal definitions aside) cannot be made with certainty at

concentrations below those associated with frank intoxication and in the absence of detailed accident descriptions. Uncertainty persists even in clinical accident investigations.

To estimate, at a minimum, the magnitude of the alcohol-crash problem in Canada, we must ask a less precise question: "How many road accidents involve alcohol-impaired road users?" We define "alcohol-impaired" as a BAC equal to or exceeding some value, usually the present statutory limit of .08% w/v. We presume, based on this definition, that persons above the legal limit were alcohol-impaired, while those below the limit were not. This approach, although subject to error, is based on experimental and epidemiologic data indicating that certain blood alcohol concentrations are associated with decreases in human performance of skills related to the driving task and an increased likelihood of accident-involvement. Practical limits on available data necessitate this presumption. Some proportion of road users with BACs above the "minimum" impaired concentration will not have "caused" the accident and may not have been "impaired"; however, some proportion of road users with BACs below that threshold concentration will have "caused" the accident and may have been "impaired" as well. The presumption is arbitrary but not capricious--and essential to further analysis.

3.4.1 Alcohol and fatal road accidents. Among the most serious of road accidents are those resulting in the death of one or more persons. Investigations of accidental death, especially those due to motor vehicle accidents, often include routine tests for the presence and amount of alcohol, at least in the majority of drivers and pedestrians killed. Although fatal accidents comprise only about 1% of all traffic accidents, more information about alcohol involvement is available for this class of accidents than any other. In fact, perceptions about the magnitude of the alcohol-crash problem seem based almost exclusively on fatality data.

United States and abroad. Early official statistics underreported alcohol involvement in fatal accidents; varied greatly from jurisdiction to jurisdiction; and created an impression that alcohol was not a

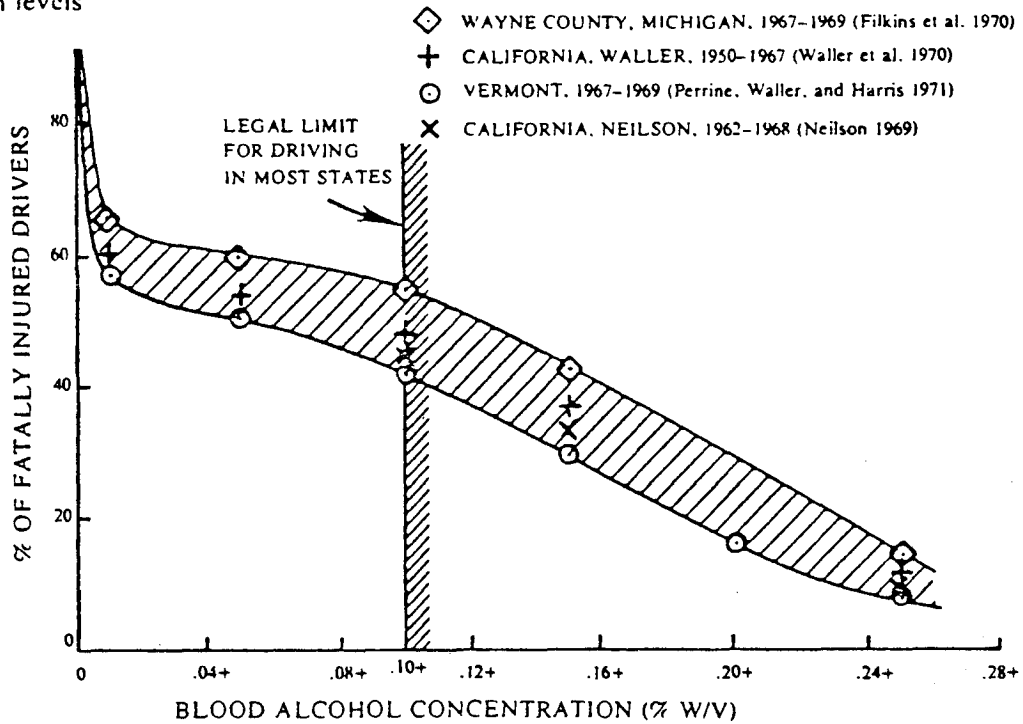
significant risk factor (Schmidt and Smart 1963; Borkenstein 1978). Special studies (uncontrolled and controlled) conducted over a period of 30 years reversed this perception. At present, for example, a common statement in the literature is that alcohol-impaired drivers cause 50% of all fatal accidents. This, however, is demonstrably untrue (Zylman 1974).

Jones and Joscelyn (1979a) presented a summary of findings from epidemiologic studies of fatally injured drivers in the U.S. (Figure 25). In these studies, selected for adequate design, execution, and number of subjects, 40-55% of fatally injured drivers had BACs exceeding the legal limit (.10% w/v) in most States. In European countries reporting comparable data, the proportion of drivers exceeding .10% w/v may be somewhat less than this range (OECD 1978). Jones and Joscelyn (1979a) also reviewed findings of alcohol involvement in adult pedestrian fatalities in the U.S. The percentage of victims with BACs exceeding .10% w/v ranged from 31% to 43%. In the United Kingdom (England and Wales), percentages ranged from 20% to 25% for pedestrians with BACs greater than .08% w/v (OECD 1978).

Canada. The Traffic Injury Research Foundation of Canada has served as the principal source of statistics on alcohol use by persons fatally injured in road accidents. Under the sponsorship of several governmental and private agencies, the Foundation has collated data from police accident reports and coroners' records for seven of the ten Canadian provinces since 1974. The database on traffic fatalities, established and maintained at the Foundation (see Simpson, Page-Valin, and Warren 1978), provided the basis for a series of summary reports focused on the "impaired driver" (Traffic Injury Research Foundation of Canada 1975; Simpson, Warren, and Page-Valin 1977; Simpson, Warren, Page-Valin, and Collard 1978; Warren, Simpson, and Chattaway 1980). In 1984, the Foundation prepared another report, entitled "Alcohol and Fatal Road Accidents in Canada: A Statistical Look at Its Magnitude and Persistence" (Beirness et al. 1984), sponsored by the Department of Justice, Canada. This report presented detailed data on the use of alcohol by persons fatally injured in road accidents, again focusing on

FIGURE 25

Percentage of drivers fatally injured in crashes with BACs equal to or greater than given levels



Source: Jones and Joscelyn-1979a, p. 12.

alcohol-impaired drivers. The report dealt with the persistence of the alcohol-(fatal)crash problem over the past decade; the characteristics of victims and road accidents as a function of BAC; and the differences among seven provinces, comparing the magnitude and characteristics of the problem. We make no attempt here, therefore, to duplicate that report. We do bring out, however, some of its findings.

(We should note here that the Fatality Database maintained by the Foundation is not yet a truly national database. Data on traffic fatalities in Nova Scotia, Quebec, Newfoundland and the Territories are not now included in the database. The historical reasons for not including these jurisdictions have to do with the rate of testing for alcohol and the accessibility of data. These and other factors, and their implications, have been discussed in earlier reports [Simpson and Heayn 1975; Simpson, Warren and Page-Valin 1977]. The Foundation has initiated a program to develop a national database to monitor alcohol-involvement in fatal road accidents, including those in which alcohol-impaired persons not dying in those accidents are counted. Until this program receives the required funding, the present Fatality Database offers the best available basis for estimating the magnitude of the alcohol-[fatal]crash problem in Canada. "Best", in this context, means "indirect". Lacking comprehensive data on persons involved in fatal road accidents, we currently use the number of drivers fatally injured and tested for BAC as an indicator [not a measure] of the extent of the problem. Although far from perfect, this indicator serves, in our opinion, as an adequate basis for analysis.)

Table 7 presents data on the BAC of automobile drivers fatally injured in road accidents in seven Provinces (British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, New Brunswick, and Prince Edward Island). Although the number of drivers has increased and decreased over the years, the percentage of tested drivers with a BAC exceeding the present statutory limit (80 mg%) has remained remarkably constant: between 45 and 51%! Not all drivers, however, are tested for BAC.

TABLE 7

ALCOHOL DETECTED IN FATALLY INJURED
AUTOMOBILE DRIVERS ONLY
 (16 AND OLDER, DEATH TIME WITHIN 6 HOURS
OF CRASH), SEVEN PROVINCES, 1973 TO 1982

<u>YEAR</u>	<u>AUTO DRIVERS WITH BAC POSITIVE AS A PERCENT OF:</u>		<u>AUTO DRIVERS WITH BAC >.08 AS A PERCENT OF:</u>	
	<u>ALL DRIVERS</u>	<u>ALL DRIVERS TESTED</u>	<u>ALL DRIVERS</u>	<u>ALL DRIVERS TESTED</u>
1973	52.3	59.4	44.0	50.0
1974	51.5	59.0	41.5	47.5
1975	53.2	59.3	42.1	47.0
1976	51.1	60.3	40.7	48.0
1977	48.0	57.4	39.5	47.2
1978	49.5	57.3	41.1	47.6
1979	48.3	57.2	40.3	47.8
1980	48.7	59.9	40.1	49.3
1981	51.7	59.9	43.7	50.7
1982	47.3	56.4	39.3	47.0

Source - Traffic Injury Research Foundation of Canada, 1984

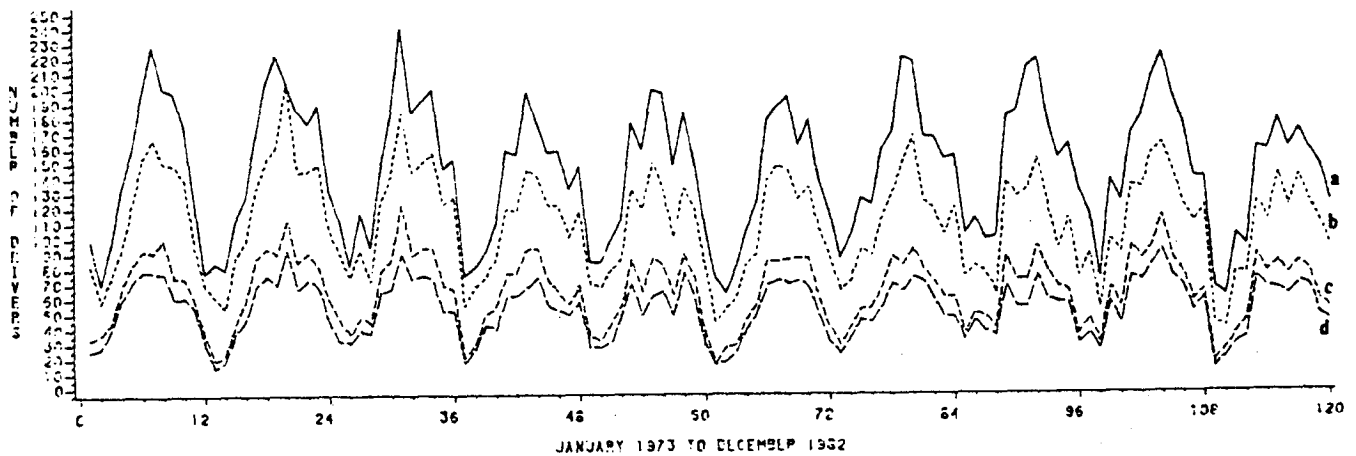
Kannemann and Warren (1980) developed a "general inferential methodology for prorating untested cases to various BAC levels based on the magnitude of other characteristics they possess". Applying this method, they estimated that 55% of all fatally injured drivers had been drinking and that 45% had BACs exceeding the legal limit. Their estimates, based on data before 1977, compare closely to data based only on persons actually tested for BAC. We have confidence, therefore, that the proportion of alcohol-impaired drivers, independent of the rate of testing, has remained almost constant over time.

Beyond percentages of fatally injured drivers who had been drinking, we also examined trends in the number of drinking drivers killed in road accidents between 1973 and 1982. Using information from the Fatality Database, we performed "time-series analyses" in order to detect any changes in indicators of the magnitude of the alcohol-(fatal)crash problem. Figures 26 and 27 (taken from Beirness et al. [1984], pp. 57, 61) reproduce graphically the data used in these analyses. Figure 26 presents, by month and year, the number of fatally injured drivers in the seven study provinces; the number tested for BAC; the number of drivers with positive BACs ("had been drinking"); and the number with BACs exceeding the legal limit. Figure 27 presents what is generally considered a "purer" indicator of the alcohol-crash problem--drivers fatally injured in single-vehicle accidents on nighttime weekends. "Single-vehicle driver fatalities" as a group of road accident victims is a better indicator because driver responsibility for the accident becomes less of a factor. Including all driver fatalities may also include many drivers killed, but not responsible for, the road accident causing their death.

As reported in Beirness et al. (1984, pp. 9-11), time-series analyses revealed only one significant trend: the seasonal variation evident by visual inspection of Figures 26 and 27. Changes over time are not statistically significant, but are attributable to random fluctuations and, perhaps, to the influence of less tangible factors (e.g., the state of the economy). Based on these Canadian data, we estimate that about 50% of fatal road accidents involve drivers who had been drinking.

FIGURE 26

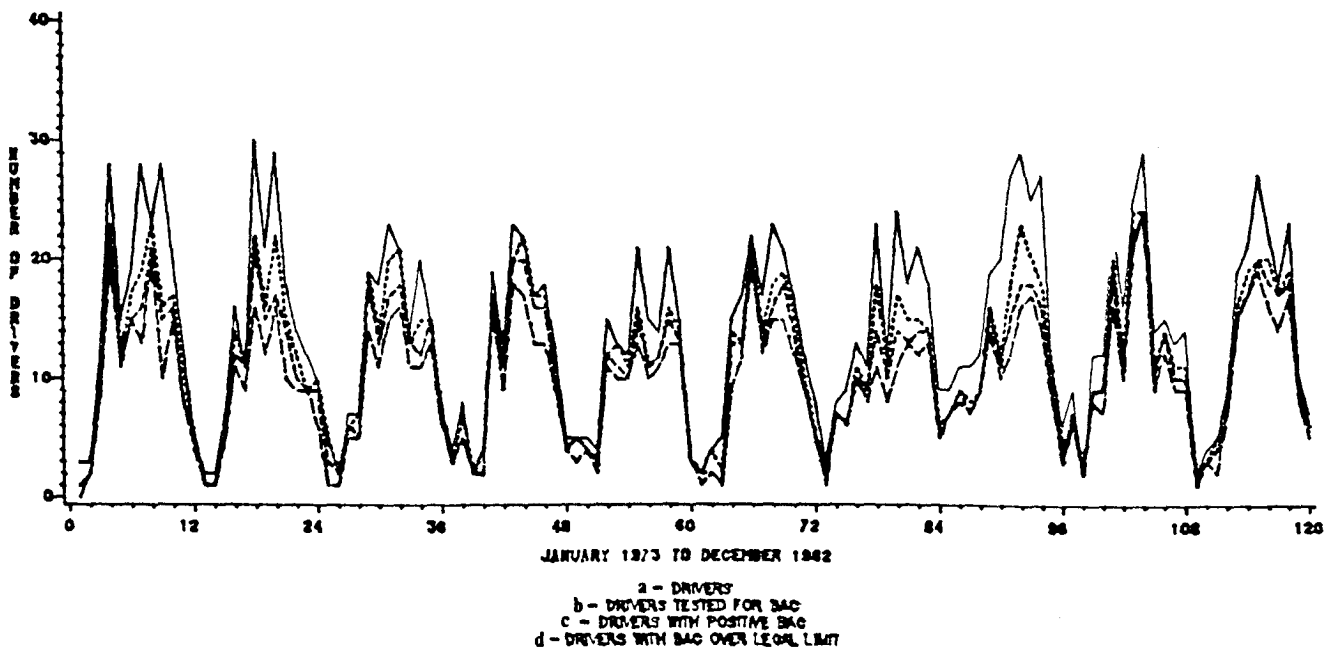
DRIVER FATALITIES BY MONTH AND YEAR (SEVEN PROVINCES, 1973 TO 1982)



a-DRIVERS
b-DRIVERS TESTED FOR BAC
c-DRIVERS WITH POSITIVE BAC
d-DRIVERS WITH BAC OVER LEGAL LIMIT

FIGURE 27

**DRIVERS FATALLY INJURED IN SINGLE VEHICLE ACCIDENTS
ON WEEKEND NIGHTS BY MONTH AND YEAR
(SEVEN PROVINCES, 1973 TO 1982)**



Furthermore, this estimate has not changed over the period between 1973 and 1982.

Simpson and Warren (1979) reported on the characteristics of fatally injured pedestrians in Canada who had BACs .08% w/v or greater. Using the assumption that victims not tested for blood alcohol had a zero BAC, they found that at least 224 of 734 victims (30.5%) had consumed detectable amounts of alcohol. Table 8a and 8b present their data broken down by age and BAC ranges. The minimum percentage of victims in higher BAC ranges (greater than .20% w/v) was 13.9%. Over 70% of the fatally injured pedestrians who had been drinking had BACs at or over .08% w/v. These figures are, undoubtedly, conservative.

3.4.2 Alcohol and injury accidents. Although personal injury accidents (those involving no fatalities) occur much more frequently than fatal accidents, only fragmentary data exist on the involvement of alcohol in these incidents. A study by Holcomb (1938) found that 25% of injured drivers, compared to 2% of at-risk drivers, had BACs exceeding today's legal standards for alcohol impairment. Since that landmark study, only a handful of special research studies have produced data on alcohol and injury accidents. Problems related to legal and practical constraints (for example, the requirement for informed consent, the ability and willingness of hospital emergency departments to cooperate) account for the paucity of present information (Donelson et al. 1980; Warren 1981). What data exist indicate that:

- o the prevalence of alcohol use among all injured drivers is less than that among fatally injured drivers; and
- o the prevalence of alcohol use among injured drivers increases with increasing injury severity.

United States and abroad. Jones and Joscelyn (1979a,b) reviewed North American studies of alcohol involvement in nonfatal crashes. Allowing for differences in key variables (for example, time of day, geographical area, etc.), they estimated that between 9% and 13% of drivers injured

Table 8A

NUMBER OF PEDESTRIAN FATALITIES AT VARIOUS BAC LEVELS

AGE RANGE	BAC LEVELS					TOTAL
	<80	80-120	121-200	201-300	>300	
1-14	4	0	0	0	0	4
15-29	13	3	16	22	7	61
30-50	12	3	16	29	14	74
51-64	10	2	8	18	8	46
65+	21	3	11	3	1	39
TOTAL	60	11	51	72	30	224

Table 8B

AGE DISTRIBUTION OF IMPAIRED (BAC > 80 MG.%)
PEDESTRIAN FATALITIES

AGE GROUP	NUMBER OF VICTIMS	PERCENT OF TOTAL
1-14	0	0
15-29	48	29.3
30-50	62	37.7
51-64	36	22.0
65+	18	11.0
TOTAL	164	

Source: Simpson and Warren-1979, p. 34,35.

in traffic accidents had BACs exceeding 0.10% w/v. Farris, Malone, and Kirkpatrick (1977) combined Huntsville, Alabama, and San Diego, California, data on injured drivers and reported that 12% had BACs .10% w/v or greater. McLean and Robinson (1979), reporting results of the Adelaide In-depth Accident Study, found 14% of injured automobile drivers had BACs greater than .08% w/v.

Other studies suggest somewhat higher rates of alcohol-involvement in injury-producing collisions. One study conducted in Australia found that 20% of injured drivers had BACs greater than .05% w/v (Gay et al., 1978, cited in Rockerbie, 1979, p.1). Terhune and Fell (1981) reported that 25% of drivers participating in a New York study had been drinking, and that 20% had BACs .10% w/v or greater. They noted that this finding is a conservative estimate for several reasons, including the fact that 311 persons refused to cooperate in the study (29.3% of the total number of eligible cases).

Canada. Two recent studies of alcohol use among persons injured in traffic accidents have been conducted in Canada. Rockerbie (1979) and Parkin et al. (1980) reported a study on 728 traffic accident victims admitted to the emergency ward of a British Columbia hospital. Of the 422 drivers included in the study, 26% had BACs in excess of .08% w/v. Although the severity of injury of victims who had been drinking did not correlate well with BAC values, these accident victims as a group sustained more serious injuries than nondrinkers.

Warren et al. (1982) reported a year-long study conducted at four major hospitals in the Province of New Brunswick. Of 2,545 drivers, passengers, and pedestrians reporting for treatment, 1,460 (57%) met eligibility criteria. A requirement that the research protocol not interfere with emergency medical care excluded a large number of persons with serious injuries. Of those eligible, 1,212 (83%) agreed to provide specimens for alcohol analysis. In all, data on blood alcohol were obtained for 1,148 patients, 45% of the total number of cases and 78% of those eligible to participate. Findings indicated that, among drivers:

- o at least 28% had been drinking (greater than or equal to .02% w/v);
- o at least 21% had BACs in excess of the statutory limit (greater than or equal to .08% w/v); and
- o at least 10% had BACs in excess of .15% w/v.

Lower percentages in these categories were found for injured passengers (17%, 11%, and 4%, respectively). Using a method to infer BACs of nonrespondents, Warren estimated that at least 34% of the injured drivers reporting to emergency wards had been drinking, 27% having BACs in excess of the statutory limit. In addition, the percentages of those evidencing use of alcohol increased with injury severity.

The results of these Canadian studies provide additional evidence that alcohol use among injured drivers, especially among those who are seriously injured, exceeds earlier estimates of 9-13% (Jones and Joscelyn 1979a,b). Lower estimates may have resulted from impressions gained from police reporting of alcohol-involvement in injury accidents, which had been shown unreliable (e.g., Rockerbie 1979). Nonrespondent bias has also contributed to possible underestimates of the prevalence of drinking in injury populations. More important than these factors, however, may be the total absence of systematic research on this population of accident victims. And, as Warren et al. (1982) pointed out, unless constraints to research in this area are removed, more reliable estimates of the alcohol-(injury)crash problem will not become available.

3.4.3 Alcohol and property damage accidents. The most common type of traffic accident involves "only" property damage. The relationship between alcohol use by drivers and property damage accidents has received little attention from researchers compared to fatal and injury accidents. In one of the few research studies to investigate alcohol involvement in crashes with no indication of personal injury, Borkenstein et al. (1964) found that 5% of 4,570 drivers had BACs of .10% w/v or greater. One might assume that routine investigations of property damage accidents by police would provide extensive data on

alcohol involvement. However, for numerous reasons summarized by Zelhart and Schurr (1977), reliable estimates of the extent of drinking among these accident-involved drivers are not possible based on police accident reports or adjudication statistics.

3.4.4. The magnitude of the alcohol-crash problem in Canada. The findings above provide a starting point for estimating the magnitude of the alcohol-crash problem, that is, the percentage of road accidents of different severity attributable to, at least in part, the impairment of road users by alcohol. Estimates based on available data remain only rough approximations. This is especially so for the most common and least studied groups of accidents, those resulting in injury or property damage only. That reviewers of research have had to rely on less than ten studies for periodic reanalysis over the years points to the dearth of current, representative data (Jones and Joscelyn 1979a; Reed 1981; Donelson and Beirness 1984).

Because of constraints on the depth and quality of information about alcohol and road accidents, one convenient approach to estimating the magnitude of the problem is to consider "alcohol-involved" road accidents as "alcohol-caused" road accidents. In other words, if alcohol is found present in one or more persons involved in a road accident, then we assume that the alcohol present had an effect on behaviour but for which the road accident would not have occurred. Obviously, very low amounts of alcohol, if present, make this assumption tenuous. As discussed above, we usually select a BAC (for example, the statutory limit, .08% w/v) beyond which we can assume with greater certainty not only the presence of alcohol but also the adverse effects of alcohol on the ability to drive. This approach to estimating the magnitude of the alcohol-crash problem results in the following figures:

- o 50% of fatal road accidents;
- o 25-30% of injury road accidents; and
- o 5-10% of property-damage-only road accidents.

These rates are often used in conjunction with statistics on the number of road accidents occurring in different jurisdictions at different times, even though objective data on alcohol use by persons involved in those road accidents are not obtained or available (for example, Noble 1978; Organisation for Economic Co-operation and Development 1978; Comptroller General of the United States 1979; U.S. Department of Transportation 1968; Jones and Joscelyn 1979a). Applied to Canada in 1982, we can estimate that alcohol may have played a contributory role in:

- o 1,800 fatal accidents (50% of 3,597);
- o between 39,200 and 47,000 injury accidents (25 to 30% of 156,779); and
- o between 24,300 and 48,600 property damage accidents (5 to 10% of 485,801 [1979 data, the last available]).

In their analysis of the alcohol-crash problem in the United States, Jones and Joscelyn (1979a) cautioned potential users of these kinds of estimates:

The above figures, while indicative of a large-scale national problem, do not, of course, prove that alcohol caused the crashes in which drinking was involved. Traffic accidents are probabilistic, with many factors entering into the probability equation. The most that can be said on the basis of epidemiologic evidence is that, on the average, alcohol, present beyond a certain amount, is associated with increased crash risk. In-depth analyses of the conditions surrounding the crashes would have to be made to support stronger statements about causation. While such analyses have been made of the roles of many other factors, the role of alcohol has not been subject to the same close scrutiny. Only rough assessments have been made of alcohol as a causal factor in crashes. Nevertheless, these studies suggest that drivers who are responsible for crashes more often have high BACs (i.e., greater than or equal to .10% w/v) than drivers who are not responsible for crashes. (p. 34)

Other authors have taken stronger exception to estimates of "alcohol-involved" road accidents. Of particular note, Zylman (1974a) published a detailed analysis that stands today, in this author's opinion, as a definitive study of issues surrounding statements of "alcohol involvement" in fatal road accidents. He developed his estimates "based largely on the most reliable research available, and partially on empirically based guesses" (p. 200). He also carefully disaggregated highway deaths into numerous subcategories of victims and circumstances to assess the portion of each that may have "involved alcohol" in some causal way. Zylman concluded the following, based on his findings:

Considering the fact that each research study from which these figures are derived is biased to the high side because of incomplete reporting, these figures must, in general, be regarded as high estimates. Ultimately, when blood specimens are taken from victims of multivehicle crashes with the same diligence as from single-vehicle crashes, when victims who die from daytime crashes are as likely to be tested as those from nighttime crashes, when non-responsible victims are tested with the same frequency as responsible victims, and when ways are found to allow for those who survive more than 6 hr after their crash, it may be found that the actual frequency of alcohol-involvement in fatal crashes is in the range of 25-34 percent. (p. 202)

We recommend highly the reading of Zylman's original article to the reader interested in gaining a greater appreciation of the problems involved in estimating accurately the magnitude of the alcohol-(fatal) crash problem. Despite the report by Zylman, the tendency to overestimate and "overdramatize" the magnitude of the alcohol-crash problem with uncritical use of road accident statistics has continued (Gusfield 1981; Reed 1981). One concern of experts in the field is that "over-emphasis on alcohol" detracts from efforts to increase knowledge of the complexity of the problem, beyond the citing of large numbers as a preface to informational campaigns (Zylman 1974b).

As the issue of "drunk driving" once again began to command attention in North America, another attempt to develop more precise estimates of the magnitude of the problem was published. Reed (1981), following the work

of Hurst (1970), reanalyzed data from controlled studies to estimate the number of road accidents that would not have occurred had all drivers not consumed alcoholic beverages. In other words, the number of accidents prevented by a "perfect" drinking-driving countermeasure. Based on his reanalyses of fatal crash data from Vermont (Perrine et al. 1971); injury crash data from Huntsville, Alabama (Farris et al. 1976); and property damage crash data from Grand Rapids, Michigan (Borkenstein et al. 1964), Reed estimated the expected reductions in road accidents if all drivers had a zero, or negative, BAC:

- o 23.7% of fatal road accidents;
- o between 8.2 and 15.8% of injury accidents; and
- o 5.7% of property-damage-only accidents.

Applying these same percentages to Canada as of 1982, we can estimate the number of road accidents prevented if no one had driven after drinking:

- o 863 fatal accidents (24% of 3,597);
- o between 12,500 and 25,100 injury accidents (8 to 16% of 156,779); and
- o 27,700 property damage accidents (5.7% of 485,801 [1979 data]).

These figures are about half those based on estimates of "alcohol-involved" road accidents. Because Reed assumed for the purposes of his analysis a "perfect countermeasure", his estimates represent the maximal gains possible by focusing solely on alcohol use by road users and by completely separating driving from drinking.

Discussions of the magnitude of the alcohol-crash problem often seem unduly academic and undoubtedly leave those concerned with "doing something about the problem" with a dispirited view of ivory-tower types who love playing with numbers, not working toward a common goal of

reducing the problem. Issues related to the magnitude of the problem run deeper than they might first appear. Let us first agree that "the problem is big", whether 24% or 50% of fatal road accidents are "caused" by alcohol. Next, let us accept that "something must be done" to reduce the problem. Finally, we are left with the question, "Have we made any difference?"

In the absence of precise measures of the magnitude of the problem over time, the effectiveness of our overall response, and the effectiveness of specific programs, cannot be known. The complexity and diffuseness of the problem allow a great diversity of independent action programs. Without adequate knowledge of how and to what degree the extent and characteristics of the problem change over time, we can never know how, or which, programs proved effective. If we acknowledge the need for such information, then we also have to accept long-standing recommendations from researchers concerning the development and application of methods to monitor and to define more accurately the magnitude and characteristics of the alcohol-crash problem. Viewed in this way, research supports action programs and assists in their refinement. In this context, we believe that the following areas warrant increased support:

- o development of methods to estimate nonrespondent (refusal) bias in surveys, as well as methods to estimate alcohol use among persons involved in road accidents and not tested for BAC;
- o application of epidemiologic methods long used in health studies of heart disease and cancer to the study of road accident risk and consequences; and
- o establishment of a comprehensive, national database dedicated to alcohol and road accidents, bringing together data from diverse sources to monitor the magnitude of the problem and to evaluate progress over time.

To ignore these areas of activity is to bestow on the next decade's reviewers the unenviable task of repeating once again the litany of informational gaps that hinder progress in this field.

3.5 Drivers Who Drink/Drinkers Who Drive

The purpose of this subsection is three-fold:

- o to provide a brief overview of the state of knowledge about drinking drivers;
- o to present selected findings from research studies done to date; and
- o to identify issues related to why more comprehensive information than presently available is needed to support future action programs.

For the reader wishing a more in-depth review of knowledge and issues, the Foundation has prepared a report entitled "Characteristics of Drinking Drivers" (Donelson, Beirness, and Mayhew 1984), sponsored by the Department of Justice, Canada. We also recommend referring directly to other reviews and articles cited both in this report and in others (Jones and Joscelyn 1979a,b; Vingilis 1983), especially for more detailed discussions of research findings and the methods by which they were obtained.

3.5.1 An overview of the present state of knowledge. Beyond alcohol and alcoholic beverages as "causes" of road accidents, we have to address a fundamental question: Who is the drinking driver? Among all Canadians we are most interested in several groups of drivers who consume alcoholic beverages at least occasionally (or, conversely, groups of drinkers who operate motor vehicles):

- o people who drive after consuming alcohol (drinking drivers);
- o people who drive after consuming amounts of alcohol that impair their ability to drive (alcohol-impaired drivers);
- o people who are arrested and convicted for alcohol-related driving offences; and,
- o people who are responsible for road accidents as a result of alcohol impairment (accident-involved alcohol-impaired drivers).

These groups (or categories) are not mutually exclusive over time. For example, a person in successive weekends might be a drinking driver one night and an alcohol-impaired driver another. The dynamic nature of drinking-driving behaviour makes it very difficult to answer the apparently simple question asked above. Labels like "drinking driver", "drunk driver", "killer drunk", and "alcoholic driver" tend to conceal more than they reveal about the attributes and characteristics of people so categorized. Furthermore, to define "problem" drinking-drivers as those convicted for alcohol-related driving offences is a tautology that offers little or no insight into personal and social dimensions of drinking-driving problems.

Over the years, many reports and articles have appeared that describe drivers who drink and drinkers who drive. The great volume of relevant literature, when carefully reviewed, does not offer a corresponding amount of useful information. For example, studies of road users--especially drivers--rarely examine patterns of alcohol consumption; surveys of alcohol and other drug use rarely obtain data on driving habits. Investigations conducted from the point of view of "road safety" or of "alcohol and health" have not studied in-depth the dynamics of drinking-driving behaviour among persons representative of populations of interest.

Even surveys purporting to investigate "opinions, attitudes, and practices" concerning drinking and driving lack depth. For example, the Traffic Injury Research Foundation of Canada (1983a) reviewed 45 questionnaires designed for face-to-face as well as telephone interviews in its efforts to identify a survey instrument adequate for a study of drinking and driving among youth. Data on the following variables were required: demographic characteristics; drinking (knowledge, attitudes, and practices); driving (practices, attitudes toward risk-taking); drinking-driving (knowledge, attitudes, and practices); and experiential outcomes of measured practices. Although many of the existing questionnaires tap some of those dimensions, none covers them all. Our review of the state of knowledge also revealed that almost all studies to date have examined some aspects of drinking drivers and their practices but

that very few have achieved the comprehensiveness required to characterize adequately the diversity and complexity of this all-too-human problem.

3.5.2 Selected findings from research studies. By "research studies" we mean surveys and clinical case-studies of drinking- and drinking-age populations, conducted in different settings by a variety of techniques and methods. These studies range from in-depth personal interviews with groups of drinking drivers who have experienced problems to less comprehensive, questionnaire-based surveys done at roadside. Each approach, of course, has advantages and disadvantages, and all have limitations. For example, in-depth interviews provide an opportunity to explore personal and social dimensions of people who engage in drinking-driving behaviour. Roadside surveys allow the measurement of actual blood alcohol concentrations of the driving population at risk of accident involvement. A very few studies have combined these approaches. A dilemma encountered by researchers is that the more in-depth and comprehensive the study, the fewer number of subjects and the more localized the area covered. The results of these kinds of studies, therefore, provide good insights and highly suggestive directions for additional research in other jurisdictions; however, their results can rarely be generalized beyond the subjects and areas studied. In contrast, large-scale surveys of populations of interest provide fair estimates of the magnitude and prevalence of drinking-driving problems, but cannot (except at costs often considered prohibitive) obtain much beyond basic descriptive data.

What follows is a brief summary of selected findings from research studies, with emphasis on those conducted in Canada.

Surveys of drinking- and driving-age populations. Smart and Fejer (1976) reported a study of high school students, their drug use and driving experience. Data were collected by means of an anonymous questionnaire administered in the classroom. Of 1,538 students, 710 (46.9%) had driven at least once in the past year. The number of miles driven was generally low; 59% had driven as much as 5,000 miles and only

9% had driven more than 30,000 miles. Over 90% of those who drove reported using alcohol, and 56% of all drivers reported drinking and driving. Only 2.7% admitted to having an "alcohol-influenced" traffic accident.

Jaeger, Fleming, and Appenzeller (1975) reported the findings of a survey of licenced drivers between the ages of 16 and 49 in South Carolina. About 72% of those interviewed reported using alcohol in the past year, and 52.3% of these drivers admitted to driving after use of alcohol. Of the drinking drivers, most indicated that they did so at least monthly.

In a recent survey of drivers' attitudes conducted for Alberta Transportation Safety (MIR Information Research Ltd 1981), no questions directly addressed drinking-driving practices of respondents. In the representative sample, however, about 25% disagreed or strongly disagreed with the statement "I would never drink and drive".

Two U.S. studies also estimated the percentage of drinking drivers in two community-based surveys. Borkenstein et al., (1964) as part of their large roadside survey and case-control study, found that, upon correction for sex, age, and education that 24% of the population at risk in Grand Rapids, Michigan, drove at least once a week after drinking. Asked how often they drove after drinking an "unsafe amount", only 4% of the total sample and 6% of the population at risk indicated they did so at least once a month. Cospers and Mozersky (1968), who compared their findings with those of Mulford (1964) and Borkenstein et al. (1964), found that 34% of their sample said they drove after drinking. Of the population at risk, 58% drove after drinking at a leisure activity.

These studies provide a glimpse of drinking-driving practices, again for the most part in the United States. The respondents may have under-reported both drinking and drinking-driving practices. Moreover, the respondents probably had little idea of how often they drove with BACs exceeding legal limits. As a whole, these studies do indicate that

driving after drinking may be a common behaviour among people in all geographic areas and economic strata. The prevalence of this behaviour alone suggests that driving after drinking cannot be considered "deviant" in the usual sense of that term. Unfortunately, we have no firm basis from these studies to estimate the prevalence of driving after BACs in excess of legal limits are attained. For those data, we must rely on roadside surveys.

Roadside surveys in Canada. National and provincial surveys have measured the prevalence of drinking drivers and described some of their characteristics. Smith et al. (1975) reported findings of a national roadside survey conducted in 1974 from Wednesday through Saturday between 10 p.m. and 3 a.m. during a 12-week period. Over 9,700 drivers were stopped at 582 randomly selected sites. Each driver was asked to provide a sample of breath and information on drink-driving habits, trip length, and basic demographic characteristics. An estimated 20.4% of the drivers had been drinking (.015% w/v BAC or higher); 6.0% had BACs exceeding the legal limit (.08% w/v).

Geographically, the percentage of drinking drivers (.015% w/v or above) ranged from 15.3% in the Maritime region to 24% in British Columbia. The percentage of impaired drivers (defined as .095% w/v or greater) ranged from 3.2% to 5.6%. The mean BAC found in each region was virtually identical (about .06% w/v). Drinking-driving behaviour did not seem to differ between urban and rural areas.

Tables 9 to 13 summarize results by age, sex, level of education, employment, and marital status. Drivers aged 30-34 years had been drinking most often, but every age group showed large percentages of drinking drivers. Even among 16-17 year olds, who are under the legal drinking age in every province, about 15% had been drinking!

Although males were twice as likely to have been drinking and impaired than female drivers, drinking-driving is by no means an exclusively male behaviour. Moreover, the mean BAC for men and women did not differ. The percentage of drinking and impaired drivers differed little when

Table 9

Percent Drivers Who Had Been Drinking,
and Impaired By Age, Canada, 1974

<u>Age: Weighted Percentages</u>						
	Wtd N	(.015+BAC)		(.095+BAC)		MEAN BAC
		%	se	%	se	
16-17	402	14.7	5.3	1.1	1.6	.050
18-19	904	19.3	3.9	2.5	1.6	.056
20-24	2,310	21.7	2.6	4.1	1.2	.061
25-29	1,597	20.0	3.0	4.3	1.5	.068
30-34	924	26.0	4.3	7.2	2.6	.071
35-39	721	22.3	4.7	3.7	2.1	.065
40-44	624	17.6	4.6	3.2	2.1	.068
45-49	533	20.8	5.3	5.8	3.0	.080
50-	966	15.2	3.5	3.2	1.7	.062

Table 10

Percent Drivers Who Had Been Drinking,
and Impaired By Sex, Canada, 1974

<u>Sex: Weighted Percentages</u>						
	Wtd N	(.015+BAC)		(.095+BAC)		MEAN BAC
		%	se	%	se	
male	7,673	21.9	1.4	4.4	0.7	.065
female	1,320	11.5	2.6	2.3	1.2	.066

Source: Smith et al. 1975; p. 40.

Table 11

Percent Drivers Who Had Been Drinking,
and Impaired By Education, Canada, 1974

<u>Level of Education: Weighted Percentages</u>						
	Wtd N	(.015+BAC) % se		(.095+BAC) % se		MEAN BAC
primary not complete	296	23.9	7.4	4.7	3.7	.055
primary complete	749	22.1	4.5	6.3	2.7	.082
high school not complete	2,561	20.1	2.4	3.9	1.1	.062
high school complete	2,821	20.6	2.3	4.2	1.1	.064
vocational not complete	66	14.2	12.9	8.8	10.5	.105
vocational complete	335	19.3	6.5	3.4	3.0	.063
university not complete	1,136	22.5	3.7	4.2	1.8	.064
university complete	1,023	16.6	3.5	2.5	1.5	.063

Source: Smith et al.-1975; p. 40.

Table 12

Percent Drivers Who Had Been Drinking,
and Impaired by Employment, Canada, 1974

<u>Employment: Weighted Percentages</u>						
	Wtd N	(.015+BAC) %	se	(.095+BAC) %	se	MEAN BAC
employed	7,363	21.0	1.4	4.3	0.7	.066
unemployed	297	26.5	7.7	5.8	4.1	.064
retired	77	15.6	12.4	1.1	3.6	.049
housewife	287	8.2	4.9	2.9	3.0	.085
student	899	17.5	3.8	2.2	1.5	.054

Table 13

Percent Drivers Who Had Been Drinking,
and Impaired by Marital Status, Canada, 1974

<u>Marital Status: Weighted Percentages</u>						
	Wtd N	(.015+BAC) %	se	(.095+BAC) %	se	MEAN BAC
married	4,459	19.5	1.8	3.9	0.9	.064
divorced	167	21.8	9.6	7.7	6.2	.086
separated	208	34.8	9.9	10.2	6.3	.086
widowed	99	19.9	12.0	1.3	3.4	.037
single	4,059	20.5	1.9	4.0	0.9	.064

Source: Smith et al.-1975; p. 41.

respondents were grouped by their level of education. The percentages differed more when employment classifications and marital status were used.

Nevertheless, what is striking is that, however these nighttime drivers were grouped, substantial percentages of drinking drivers were found. Although the authors can state that "driving after drinking was most prevalent among males, among the middle aged, among the unemployed, and among the separated and divorced drivers" (p.43), the results of this survey also indicate that these drinking drivers might represent very well the larger population of drivers who also drink (Jennings 1982).

In 1979 in Ontario, an Interministerial Committee on Drinking-Driving was directed to conduct a nighttime driver survey. The primary objective of the survey was to estimate the percentage of drinking drivers and the distribution of BACs among them. Findings from this survey differed little from the results for Ontario drivers in the 1974 survey described above. The 1974 survey found that 6.3% of the Ontario drivers had a BAC of 80 mg% or more, compared to 6.6% in 1979. The percentages, of drinking drivers by age and sex also showed little change (Interministerial Committee on Drinking-driving 1980).

In 1981, as reported by Lawson et al. (1982), provincial agencies in British Columbia, Saskatchewan, and Quebec, in cooperation with the federal Department of Transport, also conducted roadside surveys. These surveys took place in the Spring and Summer, from Wednesday through Saturday nights, between the hours of 9 p.m. and 3 a.m. The authors of the report also compared results of the provincial surveys with findings of the 1974 national roadside survey.

The proportion of drivers with BACs exceeding the statutory limit of 80 mg% showed a slight decrease in British Columbia (from 7.8% to 6.1%), but not one that reached statistical significance. In Quebec, findings indicated a significant increase both in the percentage of drivers who had been drinking and of those with BACs greater than 80 mg%. Similar

results for Saskatchewan were lower than in the other two provinces, with only 3.3% of the drivers over the legal limit.

Among the findings of the roadside surveys were statistics concerning the 16-24 year-old age group of drivers.

The most striking finding is the high proportion of drivers on the road who fell into the youngest age-group, 16-24. This is only a nine-year age group, but contributed 36% of all drivers in British Columbia and Quebec, and 52% in Saskatchewan. It appears that drivers 25-39 years old had highest impaired rates, though the highest rate was shared by the 16-24 group in British Columbia. In the other two provinces this 16-24 group had the lowest impairment rate. However, the youngest group was such a large proportion of drivers on the road that they constituted 43% of all impaired drivers in Saskatchewan, 38% in British Columbia and 27% in Quebec (p. 383, emphasis added).

These findings confirm that drivers between the ages of 16 and 24 years represent an important target for programs designed to reduce drinking-driving problems. As shown by Mayhew et al. (1981), alcohol use in this group is one of several key risk factors associated with their relatively high rates of involvement in road accidents. Along with alcohol, however, we have to consider exposure variables (when, where, and how often they drive), attitudes towards risk-taking, and other personal characteristics, few of which have received close study to date (Mayhew 1982, 1983).

Persons convicted of alcohol-impaired driving offences. Borkenstein (1975) estimated that 2,000 drinking-driving violations take place for every arrest for impaired driving, defining a violation as a trip made with a BAC exceeding .10% w/v. "Thus, in a typical [U.S.] community of one million population, with 1,000 patrol officers making two arrests per man per year, there will be 2,000 arrests and four million violators" (p.660). Persons convicted of alcohol-impaired driving cannot be considered random samples, however, due to possible selection biases at the enforcement level and differences in the adjudication process (Zelhart and Schurr 1977; Harding 1978). Nevertheless, because

many persons arrested for impaired driving come to the attention of police as a result of traffic accidents or highly aberrant driving behaviour (Perrine, Waller and Harris 1971; Harding 1978) this population of drinking drivers may more closely represent those responsible for the alcohol-crash problem.

Harding (1978) outlined the profile of impaired drivers in Saskatchewan, based on a random sample of 1,000 of the 7,994 people convicted of impaired driving in 1976. Major socio-demographic findings include:

- o about 94% of the sample were men;
- o 76.2% were non-natives, though Indians and Metis were over-represented in the sample;
- o 57% of impaired drivers were 30 years of age and under;
- o skilled and unskilled labourers and farmers accounted for about 81% of the convicted drivers;
- o 64% were drivers from rural areas; and,
- o about 13% had been convicted of impaired driving in the preceding year, and about 40% within five years.

The author stressed that the outline was a social and legal profile, and that "a clinical profile regarding the relative degree of alcohol disabilities or dependencies among this population" (p.6) had not been established.

Almost all other studies describing the population of persons arrested and convicted for alcohol-impaired driving have been conducted outside of Canada (e.g., U.S.A.--Fine et al. 1975; Sandler et al. 1975; Australia--Kornaczewski 1975; Homel 1980; South Africa--Pieterse 1979; Finland--Lindbohm et al. 1981, to cite but a few). Although profiles similar to the one reported by Harding (1978) in Saskatchewan have been developed, the only variables differentiating the convicted alcohol-impaired driver from other drinking drivers to any meaningful extent seem to be those directly related to patterns of alcohol use: quantity

and frequency of consumption and BAC (Jones and Joscelyn 1979a,b; Perrine, Waller and Harris 1971; Homel 1980). Even so, as recognized in a 1968 report on alcohol and traffic safety (U.S. Department of Transportation 1968), "no one type of drinker is exclusively responsible for alcohol-involved motor accidents..." Although specific target groups have been identified (e.g., the young drinking driver, the "problem drinker", and the "alcoholic"), research studies have demonstrated that very few groups of persons who both drive and drink are not part of the alcohol-crash and alcohol-impaired driving problems.

3.5.3 "High-risk" and "problem" drinking drivers. Research studies over the past fifty years have demonstrated a strong association between the blood alcohol concentration (BAC) of drivers and the relative likelihood (or risk) of accident involvement. If BAC were highly correlated with accident risk independent of other factors, then additional information about drinking driving beyond their BAC might be interesting, but not particularly useful. Data on BAC alone would suffice to characterize "high-risk" or "problem" drinking drivers.

The large-scale, controlled survey conducted by Borkenstein et al. (1964) clearly showed that this is not the case. These investigators not only found eight other factors (seven of them so-called "human" factors) associated with accident risk but also demonstrated that most of them influenced the relationship between BAC and the relative risk of accident involvement. As Jones and Joscelyn (1979a, pp. 51-103) discussed, this and other, similar studies show "that drivers involved in alcohol-related crashes and persons who drink and drive but have not yet crashed tend to be different from other drivers in several important respects" (p. 103, emphasis added). This "tendency to be different" means that, on average, groups of drivers so categorized have similar characteristics, but to different degrees. For example, as we might expect, people with the characteristic "alcoholic" appear more frequently in groups of persons convicted of alcohol-impaired driving than in groups of drinking drivers using the highways. This results from how different groups are selected for study and for comparison to other groups. In their review, Jones and Joscelyn summarized information

reported in the literature and compared various groups of drinking drivers in terms of many characteristics and attributes. Some of the "driver-characteristic variables" did appear more frequently in accident-involved and alcohol-impaired groups of drivers. This is not to say that the characteristics did not also appear in other groups as well. Thus, as noted above, differentiating among categories of drinking drivers becomes a matter of degree of certain characteristics, not absolute "markers" that distinguish with certainty those groups of drinking drivers who cause problems.

The need to identify target groups in the population of drinking drivers was explicitly recognized in 1968 (U.S. Department of Transportation 1968). Early target groups (e.g., social drinkers, problem drinkers) were identified on the basis of patterns of drinking behaviour. The need to distinguish one group from another stems from a concern that any given countermeasure approach may not affect all alcohol-using drivers alike, nor may certain types of sanctions deter all drinking drivers. Yet, thus far, little progress has been made in developing useful drinking-driver typologies. "Profiles", based largely upon population demographics, have provided little clarity beyond the obvious: the greater the frequency and quantity of alcohol consumption, the higher the probability of drinking-driving problems occurring.

The problem with published "profiles" and sets of risk factors culled from case-control studies lies with their limited scope in describing the personal characteristics and social circumstances of drinking drivers. For example, the lack of progress in identifying with greater reliability subsets of drinking-drivers who constitute high-risk and problematic groups has largely to do with chronic preoccupation with age, sex, BAC, and other easily obtained data. As reviewed by Jones and Joscelyn (1979a, pp. 97-99), only a few isolated studies have gone beyond demographic variables to explore "the relationships between personality traits, exposure to socio-psychological stress and the crash-involved behaviour of drinking drivers". The absence of sustained programs of research in this area have left "useful clues and insights" but not a solid informational base for action programs. Among these

"useful clues" are a group of variables characteristic of people who have high rates of traffic violations and road-accident involvement. (see Table 14).

The important conclusion to be drawn from the table is that, just as the effects of alcohol consumption on the human body may be either chronic or acute, so may the effects of exposure to stressful events be chronic or acute. The implication is that analysis of relevant data should differentiate between the contribution of the two types of effects to crash involvement of drinking drivers. Since most drinking drivers and most alcoholics do not have crashes, it is apparent that neither acute nor chronic consumption of alcohol can fully explain the overinvolvement of drinking drivers and alcoholics in certain kinds of traffic accidents. Many researchers see psychological and situational stress variables as an important causal link (Jones and Joscelyn 1979a, p. 97, emphasis added).

Thus, profiles of "problem" drinking drivers; target groups defined according to age, sex, and BAC; and fragmentary, in-depth studies of psychosocial characteristics do not yet provide an adequate basis for the development of programs that would target high-risk groups for arrest, punishment, or treatment. Findings to date do suggest that "problem drinking drivers" are not representative of the general population of drinking drivers, for example, those surveyed at roadside. On the other hand, the characteristics described, based largely on demographic variables, do not exclude any age group, any occupational group, any ethnic group, etc. This has important implications not only for the direction of future studies but also how we use present knowledge.

We identified above the group of drivers aged 16-24 years as key target for programs to reduce alcohol-related road accidents (indeed, to reduce trauma from road accidents in general). This age group spans nine years that feature not only a great diversity of people but also a number of stages marking the shift from adolescence to adulthood. To describe persons aged 16-24 years as "young drivers", however convenient, greatly oversimplifies. Within this "high-risk" group, we would expect to find

TABLE 14

DESCRIPTION OF VARIABLES COMMONLY USED IN THE LITERATURE ON PSYCHOSOCIAL
BEHAVIOUR, ALCOHOL CONSUMPTION, AND HIGHWAY SAFETY

<u>Type of Variable</u>	<u>Time Frame</u>	
	<u>Historic Conditions</u>	<u>Recent or Focal Event</u>
Psychological	Personality, attitudes, characteristic pattern of response to life events.	Pre-crash emotional state
Situational Stress	Chronic exposure to stressful social situations which may lead to abnormal behaviour triggered by certain acute emotional states.	Acute stresses occurring around the time of crash which may trigger certain emotions and patterns of behavioural response.
Patterns of Alcohol Consumption	Patterns of alcohol consumption, especially as related to response to chronic stresses and as indication of problem drinking status.	BAC at time of arrest for DWI or at time of crash.
Driving behaviour	Patterns of driving behavior, usually past traffic violations indicating possible problem driver status.	Crash involvement, traffic violations.

Source: Jones and Joscelyn 1979a, p. 98

that most members were responsible and law-abiding, although the percentage of "problem drinking drivers" may also be higher than in other age groups. In this context, Jones and Joscelyn (1979a) cautioned that identifying high-risk target groups is not necessarily straightforward:

Considerable care is required in interpreting the findings of studies of the characteristics of individuals who drink and drive. The reader is alerted to two pitfalls that are common in such interpretations. First, it is sometimes assumed that the finding that a given characteristic is associated with a higher than average alcohol-crash risk means that all individuals possessing that characteristic are high-risk drivers. A second pitfall is the assumption that different characteristics that have been found to be associated with increased alcohol-crash risk can be combined to form a composite picture of a high-risk driver and that all individuals matching that profile are high-risk drivers. Both pitfalls are to be avoided since they will lead to erroneous conclusions. No characteristics or combination of characteristics can safely be used to identify a given individual as a certain alcohol-crash threat, but can only be used for identifying the alcohol-crash risk of entire groups of drivers (p. 57).

This caution even extends to the alcoholic driving population. Filkins (1971) reported data from a 6½ year study that analyzed the driving performance of 1,247 hospitalized alcoholics. As a group, their 6-year crash rate was nearly double that of a random sample of Michigan drivers from the same age group. However, 25% had no recorded crashes or convictions during this period. Filkins warned against the "dangerous... conclusion that all alcoholic drivers are automatically unsafe drivers" (p. 6).

Another, legal issue related to the identification and control of high-risk groups was raised by Little (1968):

From a legal point of view of creating new countermeasures for an old problem, however difficult that may prove, is a less profound problem than that implied by an attempt to impose a legal restriction on a class of individuals defined solely in terms of some

social harm in the future. Our society does not shrink from dealing with offenders after the fact of the offense. Whether the response is viewed as punishment, as a deterrent or as rehabilitation is irrelevant. Whatever the view, the point is that the reaction follows the offense. What may we do about the individuals who have not yet committed a harmful act but who have been identified as risks on the basis of other personal characteristics? This is a far different question, and its implications extend significantly beyond the problem of alcoholic drivers (p. 558).

Another issue concerns the actual impact of specific high-risk groups. Staff of the U.S. Department of Transportation's Auto Insurance and Compensation Study (Klein and Waller 1970) examined the arguments (1) that a small proportion of drivers account for a large proportion of accidents and (2) that removing this small proportion of drivers from the road would substantially reduce the total number of accidents. They addressed three basic questions:

- o What fraction of drivers are involved in accidents?
- o What would be the effect on the total number of accidents of removing from the road those drivers involved in accidents?
- o What is the impact of the so-called "high-risk" driver on the total number of accidents?

They concluded that, even though substantial differences in accident likelihood do exist among drivers, it is not feasible to reduce drastically the total number of traffic accidents by dealing with only a small fraction of drivers.

A basic issue confronts us. On one hand, it is not possible to effect substantial reductions in road accidents by dealing (before or after the fact) with a small fraction of drivers who belong, or who are thought to belong, to high-risk groups. On the other hand, if we concern ourselves with the most cost-effective use of limited resources for action programs, we must conclude that drivers at higher risk of accident involvement should receive greater emphasis than others. The resolution of

this issue will not be straightforward, any more so than identifying "high-risk" drinking drivers. For example, certain measures that treat all drivers alike--seat-belt use, roadway improvements--have value in that large fractions of drivers are affected. Other measures--sentencing options for persons convicted of alcohol-related driving offences--will continue to rely heavily on dealing appropriately with relatively small fractions of drivers. The wise use of resources in doing so will depend greatly on research to advance knowledge of which options will reduce the future likelihood of "problem drinking-driving behaviour" among whom.

Present knowledge about groups of high-risk and problem drinking drivers is inadequate, to say the least. The few "predictive" models that have been developed (e.g., Lacey, Stewart, and Council 1979) have had limited applicability, especially in the areas of sentencing and driver licensing restrictions. As indicated above, the reliable and comprehensive identification of high-risk groups has not received the sustained, in-depth inquiry needed to advance knowledge. To advance the state of knowledge and to support the development (and refinement) of programs for high-risk groups, the following requirements seem paramount:

- o improved methods of measuring the attributes of drinking drivers, especially personal characteristics and social circumstances;
- o longitudinal, prospective surveys (cohort studies) of drivers who drink, to assist in developing more accurate "predictive models"; and
- o integration of studies to define high-risk subgroups with on-going and planned action programs.

We offer for consideration an example of how to fulfill these requirements, avoiding the unattractive alternative of "doing more research" before taking meaningful action.

In Canada, over 100,000 people are arrested and convicted of alcohol-related driving offences each year. The exact numbers of first-, second-, and subsequent offenders are not known. As a society, we have

an opportunity through the criminal justice system to reduce the likelihood of recidivism (the repeat of similar offences), and to reduce the risk of alcohol-related road accidents, by identifying persons most likely to engage in problem drinking-driving behaviour. We can do this in the process of arresting, convicting, and sanctioning those persons who go through the criminal justice system. Recognizing that we do not now have a reliable way of distinguishing between offenders who will or who won't come back into the system, we have to characterize adequately at least a certain proportion of those who enter the system in the first place. Over time, we can discover those characteristics that predict recidivism--repeat offences that involve both "simple" alcohol-impaired driving and road accidents due to alcohol impairment. Furthermore, we can discover which forms of punishment and rehabilitation "work for" which types of offenders, based on in-depth information about these persons. This approach is strategic in nature, not tactical. It requires pre-sentence investigation, including interviews with offenders. It also requires that information on the circumstances of arrest be compiled and integrated with more in-depth and comprehensive data on the subject, including histories of driving and criminal offences and any problems associated with alcohol consumption. It requires follow-up, monitoring over time.

As knowledge advances in the process of dealing with offenders, evaluation of different sentencing options for different groups of offenders can proceed. Evaluations would not simply "damn" or "praise" various options; they would begin to identify those groups of offenders most likely to benefit from programs shown to reduce recidivism. In time, "small" fractions of drivers would sum to more substantial numbers. Over time, this systematic, comprehensive approach to reducing alcohol-related road accidents would, in our opinion, make a sizable, measurable impact on the overall drinking-driving problem.

(A more detailed discussion of this approach can be found in the recent report entitled "Characteristics of Drinking Drivers" by Donelson, Beirness, and Mayhew [1984]).

3.6. Summary

Knowledge about drinking-driving problems remains far from complete, not only in Canada but also in the United States and abroad. Substantial gaps in information obtained to date remain. Research to define the problems of alcohol-impaired driving and alcohol-related road accidents has hardly reached the "point of diminishing returns", at least in areas beyond those traditionally pursued.

Alcohol and the ability to drive safely. We know that the ability to drive becomes impaired at high BACs, especially those equal to or greater than .15% w/v (150 mg%). Experimental studies have demonstrated that much lower BACs, even lower than present statutory limits, can adversely affect performance of certain skills related to driving. Research findings to date do not, however, "prove" that all persons with lower BACs have their ability to drive impaired by alcohol. The inconclusiveness of past research stems from the lack of methods and techniques to measure the effects of alcohol on actual driving. Furthermore, most investigators have concentrated on demonstrating the adverse effects of alcohol on driving skills. Remaining for future inquiry are the effects of alcohol on the ability to drive safely, including such skills as perception of real hazard; ability to compensate for the effects of low to moderate BACs; and the ability to maintain adequate safety margins, despite impairment of skills by alcohol. Also of importance are studies of the effects of alcohol on attitudes towards driving, especially the willingness to engage in high-risk driving behaviour.

Emphasis on justifying statutory BAC limits, or on advocating lower limits, has detracted from extending past research to address informational gaps that hinder progress in this area. In particular, we find little information on the variability of response among different subgroups of drinking drivers. Despite the inadequacy of present techniques for "reproducing" the real-world driving task, almost no funding has been allocated to developing better experimental methods for measuring the effects of alcohol (and numerous other risk factors) on

the ability to drive. To advance the limited state of knowledge, the focus of future efforts should be that of (1) defining the effects of alcohol on different groups of drinking drivers and (2) developing more refined measures of the ability to drive.

Alcohol and the risk of road accidents. The more alcohol consumed, measured as BAC, the greater the risk of involvement in road accidents. Beyond this general principle, we have only rudimentary knowledge of factors that influence the relationship between BAC and the relative risk of road accidents. Past studies have sufficed to support recommendations of statutory BAC limits. These studies also pointed to the unreliability of BAC as a measure of accident risk. Certain groups of drinking drivers differed greatly from others in terms of accident risk, as a function of variables and characteristics beyond age, sex, BAC, and other demographic descriptors.

Future efforts to define the risks of accident involvement must emphasize the variability of risks evidenced by different groups of drinking drivers and, more importantly, high-risk subsets of these groups.

Alcohol and road accidents in Canada. The magnitude of human and economic losses due to alcohol-impaired driving in Canada remains a matter for speculation and, at best, for informed guesses. Estimates based on "alcohol-involved" road accidents probably exaggerate the actual extent of the alcohol-crash problem. Based on methods that approximate the number of road accidents preventable if no one drove after drinking, we estimate that about

- o 863 fatal accidents;
- o between 12,500 and 25,100 injury accidents; and
- o 27,700 property damage accidents,

might have been prevented had no Canadian driver driven after drinking. These estimates represent maximal gains. Although the numbers are much lower than other estimates based on the percentage of road accidents

involving people who had been drinking, they still indicate the potential gains obtainable if people completely separated drinking from driving.

Measuring with greater accuracy the magnitude of the alcohol-crash problem is not an "academic" exercise, though it may appear so to some. Lacking precise indicators of the nature and extent of the problem over time, we cannot know the effectiveness of our overall social response nor the effectiveness of specific programs. Viewed this way, research and evaluation support action, refines on-going programs, and contributes to advancing present knowledge.

Drivers who drink/drivers who drive. People who drive after drinking represent the critical link between alcoholic beverages and road accidents. We categorize drinking drivers according to outcomes of drinking-driving behaviour and other basic, descriptive criteria. Present knowledge provides insights and directions for further study; information to date does not offer an adequate basis for dealing with the diversity of people and the complexity of drinking-driving problems. One explanation is our failure to support the identification of personal attributes and social circumstances of people who evidence those problems. Whatever the label--drinking driver, drunk driver, alcoholic--we have yet to penetrate surface characteristics in a way that produces data useful to the design and implementation of programs to reduce alcohol-related road accidents and alcohol-impaired driving. The advancement of knowledge need not mean "more research" as an alternative to effective action.

A strategic approach that integrates action, evaluation, and research seems needed and wanted. The cost-effective reduction of drinking-driving problems, if aimed specifically at high-risk target groups, depends greatly on reliable information concerning which penalties and programs most effectively reduce repeat offences among those who pass through the criminal justice system.

PART TWO

A REVIEW OF SOCIETAL RESPONSES TO THE ALCOHOL-CRASH PROBLEM

4.0 INTRODUCTION TO PART TWO

Any review should begin with an acknowledgement of some limiting factors inherent in such undertakings. Major limitations arise from deficiencies of the reviewer, who has less than complete knowledge and, therefore, possible biases. The "fable of the blind men and the elephant" (Puchala 1972), the law of the Drunkard's Search (Warren et al. 1977), the "Spotlight Analogy" (Popper 1963), and the classical dictate, "where one sits determines where one stands" have all been used to describe the plight of the reviewer who strives for objectivity. For purposes of the present review, this dilemma is best summarized in this observation: what seems a burning issue to one may appear a "nonissue" to others.

For example, a major issue to the technologist may be the accuracy of alternative roadside breath-testing devices; to the police officer, the major concern may relate to the expedience of such instrumentation; to the police chief, the costs of such instrumentation, or the effect upon police-community relations of increased breath-testing may be paramount; to the Crown prosecutor, the concerns may relate to admissibility, due process, backlogging of court dockets, etc.; to the practitioner involved in public information and education or rehabilitation programs, a new roadside breath-test conjures up issues related to development of accompanying informational campaigns, or the need for expanded rehabilitational facilities. For this group, whether or not increased enforcement is itself preferable to increased public information and education efforts is also at issue. Finally, for some individuals, the question "is there even a problem" is an issue.

These are, of course, only a few of the issues surrounding a single, and seemingly innocuous, undertaking: improvement of roadside breath-testing instrumentation. Yet, the implications are quite apparent: (1) no review can be expected to "do justice" to the complete spectrum of issues germane to the alcohol-traffic safety area, and (2) no unilateral attempt to identify issues is likely to be endorsed by a majority of the actors in the alcohol-crash prevention system.

Nonetheless, it is this lack of consensus within the Alcohol Safety Community regarding what the issues are, or should be, that necessitates the current review. Indeed, the very lack of consensus regarding what the issues are or should be is symptomatic of a larger malaise afflicting the Alcohol Safety Community--increasing differentiation into multiple communities functioning in a manner increasingly independent of one another and increasingly dysfunctional to the "common cause" (reduction in the magnitude of the alcohol-crash problem).

Thus, the focus of the current review is introspective, concentrating on the Alcohol Safety Community itself in relation to the problem. In Section 5.0, it will be argued that an ideal Alcohol Safety Community, working together co-operatively towards a shared goal (reduction in the alcohol-crash problem) does not exist. Rather it will be argued that:

- o the Alcohol Safety Community actually consists of multiple (and largely independent) communities, or "islands";
- o the efforts and activities of these communities frequently are counterproductive rather than complementary;
- o the members of these multiple communities are viewed more appropriately (both from within and without) as being in competition with one another rather than as integral components of a unified and programmatic effort;
- o the existence of multiple communities has become increasingly dysfunctional to the common cause.

Subsequent sections of the report review the implications of multiple communities for the development of a systematic and coordinated response to the problem, focusing on current "issues" within the field. In this regard, Section 6.0 provides an overview of the effectiveness of the effort as a whole. Two alternative interpretations ("no effect" versus "slow, but steady progress") are considered. It is concluded that it is not the effectiveness of past efforts, but rather, their cost-effectiveness (or lack thereof) that is of greater importance.

Section 7.0 explores existing countermeasures in more detail, focusing on selected countermeasure groupings. It is argued that there are many countermeasures that could be implemented, but no clear basis for choices among alternatives. The broad range of diverse countermeasures (with no clear basis for choice among them) virtually ensures that no one approach will achieve enough support to ensure a reasonable likelihood of success.

Section 8.0 deals with evaluation. The divisiveness of issues surrounding evaluation reflects the tendency of the Research Community and the Countermeasures Community to stand in opposition to each other. To resolve these issues requires a broader concept of evaluation in relation to action programs and research. Presented is a three-component model that represents Action, Evaluation, and Research as integrated functions in an iterative process to reduce alcohol-crash losses. In this conceptual framework, the role and function of evaluation bridges the gap between action and research and, viewed in this way, should dissolve existing barriers between Research and Countermeasures Communities.

5.0 THE ALCOHOL SAFETY COMMUNITY IN RELATION TO THE PROBLEM

Ideally, the Alcohol Safety Community consists of a group of individuals with a shared mission (reduction in the magnitude of the alcohol-crash problem) working together in a complementary and coordinated manner to achieve that end. However, although the basis for such a Community--its common mission--does exist, it will be argued in this section that:

- o an actual Alcohol Safety Community, working together cooperatively towards a common goal of loss reduction, does not exist.
- o the Alcohol Safety Community is sharply divided along several lines related to the alcohol-crash problem, and actually consists of multiple (and largely independent) communities, or "islands";
- o the efforts and activities of these multiple communities frequently are counterproductive rather than complementary;
- o the members of these multiple communities are viewed more appropriately (both from within and from without) as being in competition with one another, rather than as part of a unified and programmatic effort; and
- o the existence of multiple communities has become increasingly dysfunctional in a supposedly "common cause".

5.1 The Two-Communities Model

Like other problem-solving communities (Bacon 1978; Havelock and Markowitz 1973; Dunn 1980; Richman 1976; Hammond and Mumpower 1979), the Alcohol Safety Community can be said to consist of two distinct units, or communities, distinguished according to function: Research and Countermeasures. The Research Community is defined as those individuals who conduct the (largely descriptive) research necessary to document the existence of the problem, and the Countermeasures Community as those charged with the responsibility for implementing responses to the

problem. Although the lines of demarcation are not always precise, the existence of the two communities is readily apparent in virtually every review of the literature on alcohol and traffic safety (SWOV 1976; OECD 1978; Jones and Joscelyn 1979a; Raymond 1973; Perrine 1976; McLean 1979; U.S. Department of Transportation 1970; UNC 1970; West and Hore 1980), as well as in the structure, interactions, and published proceedings of the major alcohol-safety conferences (UNC 1970; Johnston 1979a, 1979b; Israelstam and Lambert 1975; Valverius et al. 1982; Goldberg 1981a).

Characteristically, these reviews reveal two sets of actors: one group documenting the magnitude of the problem, the other documenting the methods employed to deal with it. Rarely are linkages between these two groups made apparent, in particular, how one moves from recognition that a problem exists to what should be done to correct it. Knowledge simply that a problem exists (e.g., "the car won't start") tells one little about what to do about it. In the absence of knowledge regarding why the problem exists, responses tend to occur on a trial-and-error basis (e.g., kick tires, swear, pray, continue to turn key, and hope). Not surprisingly, despite periodic instances of "success", subsequent evaluations of such efforts usually show them to have failed, or at best, to have been highly inefficient. Similarly, in the absence of knowledge about why the problem exists, unsuccessful attempts to rectify the problem (e.g., cleaning the battery terminal) result in only a negative improvement in knowledge: one learns more about what doesn't work, but learns little else about what will.

Nevertheless, the Research and Countermeasures Communities seem to have evolved so that the role of the research community is restricted predominantly to demonstrating the existence of the alcohol-crash problem; the programs community, to providing solutions that work. Neither community seems to have a clear mandate for providing the requisite research that will facilitate the development of effective solutions. Of some interest, repeated demonstrations by the Research Community that the problem exists--and persists--have sometimes supported the demand for action. The existence of a Countermeasures Community (who are, after all, paid

to have solutions ready) has often given the impression that solutions do exist. Thus, "solutions" repeatedly have been implemented in the absence of appropriate problem-solving research. Predictably, the results have been unimpressive.

An "idealized" problem-solving model is shown in Figure 28. As shown in this figure, the effort proceeds from definition of the problem, through research to identify approaches to resolving the problem, to development, implementation and evaluation of responses. The feedback loop shown in Figure 28 implies a continuous, cumulative growth in knowledge about ways to improve future responses to the alcohol-crash problem. In practice, the actual "problem-solving" model differs as shown in Figure 2. This figure is essentially a repetition of Figure 29, but deletes "research to determine what will work". In Figure 29, the system moves directly from demands for action to development, implementation, and evaluation of responses. The problem-solving model shown in Figure 29 functions both in theory and in practice (as will be discussed later) essentially as a trial-and-error process with little or no corrective action possible.

Subsequent sections will explore the structure and function of the Research and Countermeasures Communities. It will be argued (1) that the existence of these two communities lends itself to the perpetuation of ineffective (or, at best, highly inefficient) responses to the alcohol-crash problem, and (2) that each community seems to view the activities (and perhaps the very existence) of the other as a major impediment to the development and implementation of more effective solutions.

5.1.1 The Research Community. For the most part, research has focused almost exclusively on demonstrating that a problem exists and that, by extension, that there is both a need as well as a justification for action. As noted by Borkenstein et al. (1964), this orientation was necessary in the initial stages of the field, as the magnitude of the alcohol-crash problem was not well defined and was not fully appreciated by the general public.

FIGURE 28
"IDEALIZED" PROBLEM-SOLVING MODEL

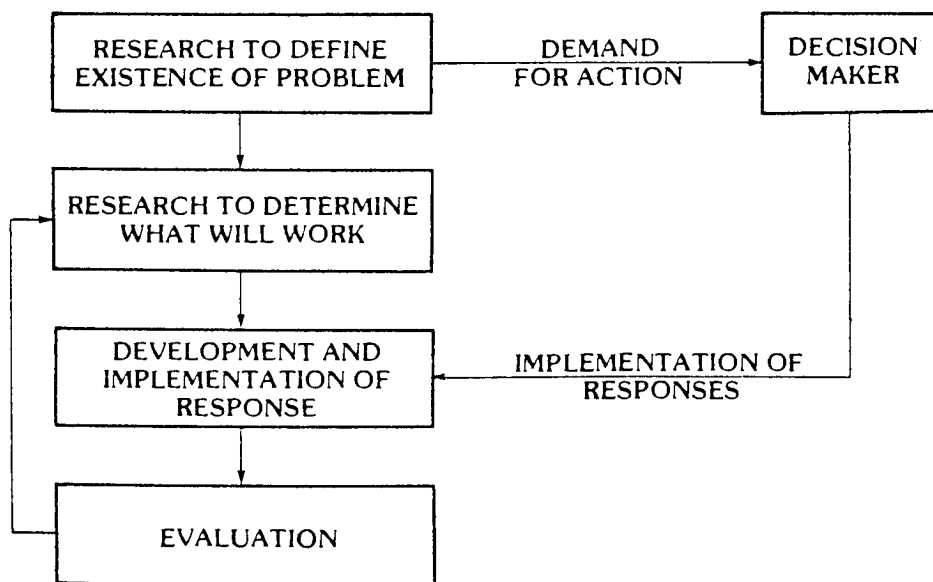
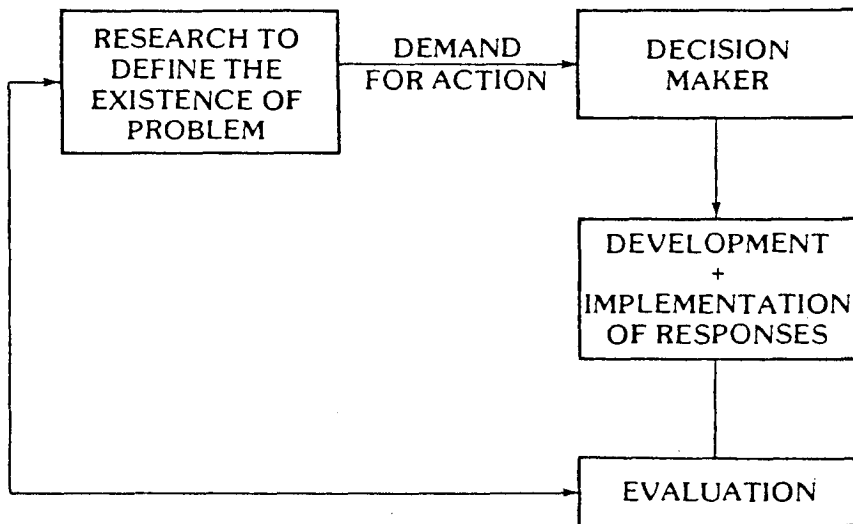


FIGURE 29
ACTUAL PROBLEM-SOLVING MODEL



One of the basic reasons for the extensive research efforts has been to attempt to dramatize the enormity of the problem and the seriousness of its effects on a complex and fast-moving society (p. 144).

Major studies conducted by Heise (1934), Holcomb (1938), McCarroll and Haddon (1962) and Borkenstein et. al. (1964) demonstrated that the alcohol-crash problem did exist and a rough approximation of its magnitude. Although two decades or more have elapsed since the conduct of these "classic" studies, research to "define the problem" continues unabated.

To date, literally hundreds of epidemiologic studies have examined the extent of alcohol use among drivers on the road (SWOV 1977; Hammond and Cameron 1982; Pantilla et al. 1981; Noordzij 1981a; Valverius et al. 1982; Morgan 1982a; 1982b; Interministerial Committee on Drinking and Driving 1980; Smith et al. 1975; Stroh 1972); alcohol use among drivers involved in serious (mostly fatal) crashes (Warren et al. 1981; Warren et al. 1980; Hetzel et al. 1975; Simpson 1977a; Terhune and Fell 1981; Moorehead 1982; Balint 1981; Linden and Valverius 1980; Parkin et al. 1980; Pieterse 1979; Sabey and Staughton 1982; Cimbura et al. 1980); and the statistical relationship between the two (Allsop 1966; Clayton 1977, 1980; Farris 1976; Goldberg 1981c; Hurst 1970, 1974; McLean 1980; Perrine et al. 1971; Simpson and Warren 1981; Warren and Simpson 1980; Warren 1976; SWOV 1976). Similarly, hundreds of experimental (or laboratory) studies have been conducted, demonstrating the effects of alcohol consumption on skills "relevant to the safe operation of a motor vehicle" (Barry 1973; Huntley 1974; Moskowitz 1978; Perrine 1974a).

Over time, of course, the sampling parameters and measurement procedures used in these studies have become more refined (Wolfe 1980a,b; Warren and Kannemann 1982a,b; Ferrence and Whitehead 1980; Carlson 1979; Hurst and Darwin 1977). One has to question, however, the extent to which these efforts have contributed to substantive knowledge--particularly, knowledge useful to solving the problem. As noted in a review by Raymond (1973):

Literature on the relationship of alcohol to Road Safety is encyclopaedic in volume and rather repetitive in content. Much of the repetition reflects the laborious process of gaining general acceptance for a set of facts by means of proving and re-proving the points made....that alcohol has a detrimental effect on driving performance, and that drinking drivers....are involved in a disproportionate number of traffic crashes.

Basic, descriptive research has provided little guidance on how to solve the alcohol-crash problem, though it has supported raising the alcohol-crash problem "onto the agenda of political controversy" and providing both the stimulus and the justification for increasing efforts to deal with the problem. The body of research cited earlier did lead to the establishment of blood alcohol concentration (BAC) in most countries (Havard 1975,1979). Nonetheless, attempts to suppress alcohol-impaired driving took place through criminal justice systems well before the conduct of this research; the establishment of statutory limits (and introduction of the breath-testing) were refinements and improvements in that mechanism, instead of an abrupt departure in how to deal with the problem. The main influence of this research was felt elsewhere--in terms of the increased scope and intensity in countermeasure activity, for example, considerable increases in enforcement (in Canada, an approximate tripling in DWI convictions between 1967 and 1971) and in penalties, and increases in educational, informational, and, more recently, rehabilitational activities.

Even if one considers the setting (and resetting) of statutory limits as an isolated example of research giving direction to efforts aimed at solving the problem, recent research has not evidenced an active search for solutions to the alcohol-crash problem. For example, little is known at present about even the most basic questions, such as why some people choose to drive while impaired and others (presumably) refrain. Similarly, although informational/educational programs often incorporate research results (pharmacokinetics of alcohol, alcohol's effects upon psychomotor skills, risk of collision, etc.), little is known regarding

what information should be provided (as opposed to the morass of information that can be, or presently is, provided) to the public to influence decisions about driving after drinking. Equally little is known at present about what people view as alternatives to alcohol-impaired driving, and why many individuals consider alcohol-impaired driving "less undesirable" than alternatives. Moreover, little is known about how certain apprehension and conviction must be, or how severe punishments must be (or the two together, considered as a linked outcome) to achieve meaningful reductions in the alcohol-crash problem, or even, meaningful reductions in the frequency of alcohol-impaired driving. Thus, past research efforts seem to have done little more than to provide ongoing reaffirmation of the existence and persistence of the alcohol-crash problem and the need for effective action. Relatively little if any research has focused on determining what that effective action might be.

The virtual absence of such research may be attributable to the existence of a "solutions" (countermeasures) community. Unlike other social-problem areas such as cancer or heart disease, in which few propose to have solutions, there is no shortage of "solutions" to the alcohol-crash problem (OECD 1978; Drissen and Bryck 1974; Raymond 1973; Fox and Fox 1963; West and Hore 1980; Ennis 1977; Whitehead 1975; USDOT 1969,1970). Not surprisingly then, unlike cancer or heart disease, only very limited resources are devoted to a search for solutions to the alcohol-crash problem (Hartunian et al. 1980,1981; Haddon 1981; IIHS 1981). Not only is the level of investment in the search for solutions miniscule in relation to other major health and safety problems, it is even less impressive compared to the traffic-safety countermeasure effort as a whole. The attached excerpt (Appendix One) from the Report of the New Brunswick (Canada) Select Committee on Highway Safety shows that less than $\frac{1}{2}$ of 1% of the road crash (preventive) effort in Canada is devoted to research. The remaining 99.5% is devoted to the implementation of "solutions".

When "solutions" already exist, it is difficult to convince funding agencies of the need for further research. Of course, it is difficult

politically to fund research at the expense of funding the solution. Thus, the existence of "solutions" to a large extent contradicts any perceived need for "further research".

More recently, perhaps in part a response to demands from the Research Community, there has been a marked growth in program evaluation; however, this pertains to the evaluation of programs often introduced in the absence of needed research-based guidance regarding what should be done in order to achieve an impact. The generally negative outcomes of this evaluative research have tended not to advance knowledge of how best to deal with the problem. Rather, the results of evaluations have tended to feed skepticism concerning the effectiveness of the effort as a whole. It has been argued variously that responses have been "primitive and unproductive", "ill-conceived, ineffectively directed", based more on "emotion" or "impassioned zeal" than on "clear understanding" or "knowledge"; that the effort as a whole has been "ineffective"; that no countermeasure response has produced a sustained reduction in the magnitude of the problem; and that there is no basis to believe that any "solution" currently being proposed will be effective. These strong judgments are reflected in the following quotes.

No one doubts....the seriousness of the alcohol (crash) problem, and yet no one really has the faintest idea what to do about it in societies where alcohol consumption is usual (Haight 1980, p. 57).

Each International Congress on Alcohol, Drugs and Traffic Safety has signified new accomplishments in developing techniques to identify, arrest and test the alcohol-impaired driver, and each conference brings to light new problems which have developed because those new techniques did not accomplish their intended purpose....The time has come to stand back and ask "Why?" (Zylman 1975, p. 179).

There is no shortage of "simple solutions" to the alcohol-crash problem--only a shortage of solutions that work. (Simpson 1977b).

It has been a consistent theme of this report that there are unlikely to be any simple answers....that there is no "magic bullet" which will solve the drink/driver problem (Homel 1980, p. 122).

If not nonexistent, the American record since 1900 in terms of prevention of any and all alcohol problems is at least abysmal....The difficulty, and this may be an alien concept to many Americans, does not lie in the phenomena; it lies in our ill-conceived, ineffectively directed, and emotionally based rather than knowledge-based modes of attempted intervention (Bacon 1978, p. 1143, 1146).

It could readily be argued that the alcoholic driver is the number one domestic problem in the United States, yet our response as a nation up to now has been primitive and unproductive (Havelock and Markowitz 1973, p. 49).

Serious questions must be addressed about the inability of existing efforts (as a whole) to produce a sustained reduction in the magnitude of the problem. In short, is there any assurance that if present efforts were expanded considerably, that there would be a noticeable improvement? (Warren et al. 1980).

The analysis of likely trends in the factors believed to be most strongly related to the alcohol-crash problem indicated that the absolute magnitude of the problem will increase substantially over the next decade (Jones and Joscelyn 1978, pp. 87-88).

The importance of alcohol intoxication as a risk factor in road accident involvement is rarely questioned. Because of this attitude, many drink-driving countermeasures are based on a recognition of the importance of the problem rather than on a clear understanding of its characteristics. This is not necessarily a bad thing....but no socially-acceptable drinking-driver countermeasure has been shown to produce a major reduction in the incidence of alcohol-related crashes (McLean 1979).

Almost everyone agrees that government should act to reduce the amount of impaired driving. The problem is how to do it (Gilbert 1981a, p. 5).

Concerning impaired driving, impassioned zeal has far too long been the prime guiding force and, in an effort to solve the problem, more attention has been devoted to mounting countermeasures and intervention programs than to identifying the precise elements of the problem (Simpson 1977, p. 121).

Pending generation of (new) knowledge, there is no apparent justification for implementing new, large-scale operational (alcohol-crash countermeasure) programs.... Proposed methods for dealing with the

alcohol-crash problem should be regarded as hypotheses until they are adequately tested and evaluated, and such tests and evaluations should most prudently be conducted on the smallest practicable scale (Jones and Joscelyn 1979a, p. 78).

These quotes suggest a widespread skepticism in the Research Community regarding the effectiveness of countermeasure efforts as a whole. Even more pronounced is the growing conviction that substantial reductions in the alcohol-crash problem will likely not result from a simple expansion of present efforts. Finally, these remarks provide a strong counterpoint to the belief that "solutions" do exist, perhaps stemming from a conviction that perpetuating this illusion is dysfunctional to the common mission.

5.1.2 The Countermeasures Community. The Countermeasures Community includes individuals and agencies who have responsibility for dealing with the problem, those expected to provide workable solutions to the problem. These individuals, paid to produce solutions that work, argue that the alcohol-crash problem exists in spite of their valiant efforts and their effective (albeit underfunded) programs. That progress is not more evident is because their programs have not received the necessary level of funding. Unlike their research counterparts, when members of the Countermeasures Community are asked for new, more effective solutions to the alcohol-crash problem, responses such as "we don't have the faintest idea of what to do about the problem" or "until further research is conducted we recommend that no further countermeasure activities be undertaken" are not widespread. Rather, solutions abound, as the 107 proposed solutions listed by Driessen and Bryck (1973) indicate (see Appendix Two).

The Countermeasures Community does not consciously promote the notion that further research is useless. To the contrary, they acknowledge the desirability of further information. They recognize, however, the paramount need for immediate action to ensure that the situation does not deteriorate. Meanwhile, they await new breakthroughs from the Research Community. Thus, it is difficult for members of the Counter-

measures Community not to view research-based criticisms of the effectiveness of the overall effort as dysfunctional to the common cause. It is this very criticism that inhibits their ability to maintain the level of effort required to achieve meaningful reductions in the alcohol-crash problem.

5.2 From Two Communities to Multiple Communities

As indicated above, solutions abound. Unfortunately, there are no clear criteria for choosing among these contending solutions. The Countermeasures Community will not likely guide choices because it contains within it a set of disparate communities, each characterized by a commitment to a given response modality as "solution": "mass public informational" programs, "educational" programs, "drinking-problem rehabilitational" programs, "driving-problem rehabilitational" programs, "punitive" programs, "incentive" programs, "technological" programs, etc. Each of these "response modalities" is based on different concepts (usually implicit) of why the alcohol-crash problem exists at current levels, and more importantly, what modifications can be introduced into the environment to promote an abrupt shift in the status quo.

These multiple response modalities reflect the multiplicity of agencies with a "shared" responsibility for dealing with the problem (Gusfield 1981). The alcohol-crash problem cuts across traditional problem-solving sectors, both public and private. These various agencies become involved because no specific problem-solving machinery has been developed to deal with this problem.

Thus, societal responses to the problem seem governed to a large extent by a "tool illusion". Rather than proceeding from a clear definition of what needs doing to the development of appropriate tools, the process seems to have proceeded more from a recognition that something has to be done to the application of any and all tools available, to do whatever may be possible. The dominance of the tool illusion can be seen in Table 15 which lists classification schemes for drinking-driving countermeasures. These classification schemes refer variously to the agencies

TABLE 15

CLASSIFICATION SCHEMES FOR DRINKING-DRIVING COUNTERMEASURES

<u>Reference</u>	<u>Classification Scheme</u>
Fox (1967)	Legally oriented, motivation to avoid accidents, physiological methods; opinion-influenced motivations; detection of alcoholics and pre-alcoholics.
Gilbert (1981b)	Exhortation; intimidation; separation; education; treatment.
West/Hore (1980)	School-based; mass education and information; in-vehicle countermeasures; legal sanctions; programs for drivers arrested for drink-driving offences; programs for alcoholics; alcohol safety action projects.
OECD (1978)	Legislative; informational; educational; rehabilitational; supporting countermeasures (indirect legislative measures, mechanical deterrents, incentive measures, identifying corrected DWIs.
Ennis (1977)/ Simpson (1977a)	Primary; secondary; tertiary prevention/intervention.
Kleinknect (1969)	Threat and punishment; education of problem driver regarding driver skills and laws; changing the problem driver's attitude; working with the maladaptive behaviour itself rather than through cognitive or thought processes.
Joscelyn/Jones (1979a)	Legal, health, public information and education, technological, systems approach.

involved, the tools at the disposal of these agencies, various characteristics of the problem (or of the target population), the temporal sequence of impaired driving, the aspect of the problem addressed, etc. Rarely do they refer explicitly to what precisely they are designed to accomplish; how they differ from, relate to, or complement other approaches; or how they constitute anything approximating a unified or holistic undertaking.

Thus, responsibility for dealing with the problem is given to many different agencies, each with a qualitatively different relationship to, conception of, and method for dealing with the problem. For example, alcohol-treatment agencies generally approach the alcohol-crash problem and the impaired driver as subsets of the larger problems of alcohol-related damage and alcohol abuse. Standardized "alcoholism" treatment systems or alcohol-abuse paradigms are applied as "solutions". In contrast, driver licencing and control systems consider the alcohol-crash problem and the impaired driver as subsets of the traffic-crash problem and of "problem drivers". Standardized licencing and control mechanisms (demerit/merit systems, suspensions, revocations, "re-educational" programs, etc.) are applied in efforts to reduce the problem. Approaches using the criminal justice system or other law-based mechanisms use the same methods and techniques to dissuade persons from alcohol-impaired driving as are applied to other realms of traffic or "criminal" behaviour.

A variety of agencies, therefore, obviously have a shared responsibility for dealing with various elements of the alcohol-crash and alcohol-impaired driving problems. Each agency approaches the problem in a qualitatively different manner, based on its approach to similar problems and guided by the array of tools at its disposal. More importantly, as mentioned above, individuals working within each of the above-mentioned response modalities accept their paradigm as providing THE solution (or most preferred approach) to the alcohol-crash problem. Of course, in the abstract, each of these approaches does hold the promise of a solution. There is, however, no consensus within the Counter-

measures Community on how best to proceed nor are there any clear criteria for choices among alternatives. The following excerpts illustrate this situation.

The central truth is that we must make up our minds to launch an all-out, adequately funded, total attack on the problem of alcoholism in America if we are to make significant reductions in the deaths and maimings on our highways for which alcoholic drivers have been responsible (Filkins and Geller 1970, p. vii.)

What appears to be happening is that one of our most serious health problems (alcoholism) is being dealt with as simply as a traffic violation. A diabetic or epileptic who comes to our attention on the street is taken to hospital. The excessive drinker, however, is taken to court. Is it perhaps time for a serious review and revision of our methods for handling such people? (Raymond 1973, p.32)

The best research evidence in this field clearly shows less recidivism among drunken drivers when their licences are suspended or revoked than when they are placed in alcohol rehabilitation programs (IIHS 1981, p. 5).

Successful participation in the San Diego SB-38 [educational] program appears to be as effective a countermeasure to subsequent DWIs as the otherwise mandated licence suspension for second offenders (Ryan and Vasquez 1981a, p. 3).

The major stumbling block to any change in the present extent to which people drink before driving...lies in prevailing social attitudes....any general change in drinking and driving practices will have to be preceded by a change in the social attitudes which foster them (Henderson and Freedman 1977a, p. 633).

In 1972 in Canada 6,221 persons lost their lives... in traffic accidents. Statistics show that 55 percent of the drivers killed in fatal crashes had been drinking....To the Canada Safety Council these facts suggested an urgent need for a continuing national public information program on the subject of drinking and driving (Farmer 1975, p. 831).

Compared to other opportunities for influencing driver behaviour, present day road safety propaganda offers little hope of bringing about any appreciable reduction in traffic accidents....Measures which lighten the task of the driver should receive highest priority (Griep 1970, p. 143).

Essentially, the Phoenix DWI Course is an educational effort to help ease the problems created by driving after drinking. It is based on the premise that an offender will be in a better position to think about DWI and to modify his behavior accordingly once he is (1) informed of the influence of alcohol on driving skills and of the consequences of drunken driving; (2) encouraged to assess his own drinking and driving behaviour; and (3) allowed to explore the ramifications of his behavior in a friendly, non-judicial group setting (Stewart and Malfetti 1970, p. 2).

Phoenix programs, which employ (an educational) approach to prevent recidivism, are currently in vogue. One problem with these programs is that they deal with the "typical drunk driver", who is not necessarily representative of all drinking drivers. Rather, those arrested for DWI may be caught because there are greater numbers of police in the areas where they live and do their drinking. Further, programs designed to prevent recidivism may not be effective because of the low probability of being arrested for DWI. Potentially, the best programs are those that combine low legal BAC's with vigorous and uniform enforcement (Whitehead 1975, p. 127).

Based on data at hand, it would seem advisable to concentrate upon enforcement rigor, rather than attempting to enact more stringent BAC limits (Hurst 1974, p. 147).

With the high incidence of impaired driving, it is imperative that we consider large-scale counter-measures that are directed to the entire potential drinking driving population. Serious consideration should be given to strategies of general deterrence and more effective police enforcement to increase drivers' subjective estimates (as well as objective estimates) of apprehension risk for DWI violations (Ennis 1977, p. 15).

If my definition of the problem is accepted, and deterrence and other approaches to affecting driver behaviour turn out to be either ineffective or

intolerably costly in the long run, I believe we can follow Little to the policy alternative: to forget about more severe laws and work for a safer environment for drunks to drive in (Ross 1981, p. 99).

Ignition interlock devices or their equivalent should be developed and evaluated as a matter of urgency (Homel 1980, p. 135).

In 1979 the Washington Legislature amended the drunk driver statute to prescribe a minimum mandatory one-day jail sentence (1979 Wash., Laws, ch. 176. Sub. H.M. 665). The author believes that this sanction is inappropriate and that it is unlikely to prove more than marginally effective as a deterrent for the offense of driving while intoxicated (DWI)This note critically examines the mandatory imprisonment statute and proposes a more effective solution to the drunk driver crisis....The recommended approach proposes a set of stringent sanctions, including fines, to be combined with a treatment program for appropriate application by the trial judge (Oliver 1980).

The lack of well-defined criteria for choices among these various response alternatives virtually ensures that no one approach will achieve a level of support required to substantially affect the magnitude of the problem. This, in turn, reduces any hope for a favourable scientific evaluation. Lacking evidence of a positive outcome, it is unlikely that the necessary level of support will ever be obtained.

5.3 The Decision-maker's Dilemma

The scenario presented above might well seem frustrating: a group of individuals (the Countermeasures Community) engaged in dogged (if not dogmatic) pursuit of specific solutions, and, opposing it, a group of individuals (the Research Community, with the shared aim of loss reduction) asserting that premises underlying the pursuit of solutions are faulty, that nothing proposed by the former community has worked in the past nor, in the absence of further study, can anything be expected to work in the future. Although open debate may be viewed as healthy from some perspectives (Lakatos and Musgrave 1970), it must be viewed as

counterproductive from others. Consider, for example, the plight of the decision-maker, who must contend with the array of apparently irreconcilable positions.

The following discussion is based on classic models that assume that the decision-maker is both responsive to and reliant upon knowledge provided by "experts" (Baker 1973; Nelkin 1979; Rein 1973; Lowrance 1966; Frohlich and Oppenheimer 1972; Allison and Halperin 1972; Bobrow 1972; Cumming 1981; Freeman and Sherwood 1970; Whiting 1972). Veterans of political affairs will immediately grasp the limited validity (and naivete) of this assumption. Nonetheless, in light of the clear need for knowledge-based policy and planning, we think it useful to illustrate the "idealized" scenario.

5.3.1 Convincing the decision-maker that action is required. The Alcohol Safety Community approaches the decision-maker on a relatively united front: both researchers and practitioners are willing to acknowledge that the alcohol-crash problem still persists, that it remains at an "intolerable" level, and that further action is required. This unified "demand for action" places the problem "on the agenda of political controversy" and initiates the search for alternatives. The decision-maker solicits input from these experts regarding what can or should be done, and, at this point, the life of the decision-maker becomes complicated, to say the least.

5.3.2 Convincing the decision-maker to take an appropriate course of action. The first question posed by the decision-maker likely relates to why the problem remains at an "intolerable" level given the magnitude of the current effort. Predictably, the decision-maker receives two different responses. The researcher argues that the problem persists because past responses have been misdirected and futile, citing some 50 or more "evaluations" of informational, educational, rehabilitational, and enforcement-oriented measures, "none of which produced measurable or sustained reductions in the magnitude of the problem". In contrast, the advocate of programs argues that the problem persists in spite of the agency's efforts to eradicate it,

noting only how much larger the problem would have been in the absence of the program. The advocate might acknowledge unfavourable evaluations, but also notes that the results are far from conclusive (failure to measure results does not necessarily mean that none were produced); that even if the results are viewed as "conclusive", they do not apply to THIS program, and that even if these results do apply to this program, this is only evidence that the program has been underfunded from the beginning. The second question posed by the decision-maker is more explicit: What can be done to reduce the "intolerable problem" that everyone agrees exists at present? The Countermeasures Community responds with a deluge of solutions (perhaps up to 107 solutions as listed in Appendix Two). Proponents of any of these solutions will then argue that it will be better, more effective, more cost-efficient, etc., than the other 106. The decision-maker then turns to the researcher, who repeats the contention that none of these (107) solutions can be expected to produce a sustained reduction in the magnitude of the problem, that further research is needed.

5.3.3 From the need for action to action: Weighing the evidence.

The decision-maker, having been convinced that the problem remains at an "intolerable" level, and having acknowledged the need to act now to reduce it, recognizes that action, not research, will reduce the problem in the short term. Moreover, by the time any needed research has been done, the problem may have reached crisis proportions, or the crisis may have long since passed. The decision-maker, in seeking a decision to make, also recognizes that the two communities are in accord on one point: although nothing is working, this does not mean that any of the programs have been ineffective, and that until "better", "more effective" approaches are available, our present approaches must be maintained or improved to "keep the lid on", i.e., ensure that the problem does not get even worse. To curtail existing programs with the problem at intolerable levels could hardly be defended.

This kind of response to the pronounced lack of direction given by the Alcohol Safety Community seems to perpetuate the status quo until guidelines for decision-making become clearer. Austin and Apps (1979) summarized this state of affairs as follows:

In attempting to determine what additional counter-measures could be implemented, the Michigan State Safety Commission could foresee no readily projected programs which would make a major impact on the incidence of alcohol involvement in traffic fatalities. However, unwilling to concede that perhaps there was little that could be done to reduce alcohol related fatalities, the Commission...agreed to host an international conference ...to discuss possible new programs which might prove more effective (p. 432)

Needless to say, there was no shortage of "new" programs and initiatives--mostly in the form of minor extensions or modifications to on-going activities. Pending a consensus within the Alcohol Safety Community concerning which (if any) of these solutions offer the greatest potential for loss-reduction, it is unlikely that any program will obtain sufficient support to have a "measurable" impact on the problem. Similarly, when viewed by the research community at large, the willingness of society to pursue ineffective responses rather than to develop the knowledge required for developing effective responses is again demonstrated.

Given that history best predicts the future, it seems reasonable to conclude that the cycle will continue, at best perpetuating the status quo, with continued attempts to "keep the lid" on the problem, but with little hope of meaningful and sustained reductions.

5.4 Summary

It is apparent that fractionation of effort has become increasingly dysfunctional to the field as a whole. Rather than working together to develop a systematic, programmatic, and comprehensive response to the problem, the Research and Countermeasures Communities continue to pursue separate courses, despite their common goal. Countermeasures are still launched in the absence of needed "problem-solving research" at a level of support insufficient for meaningful inroads. When evaluated, these programs appear ineffective and cost-inefficient, remaining subject to repeated criticism by the Research Community.

The Countermeasures Community itself, with its diffusion of responsibility for the problem, perpetuates the lack of comprehensive and complementary action programs. The commitment to an ever increasing range of alternative (and, frequently opposing) paradigms as "solutions" provides a distinct lack of guidance to the decision-maker, and virtually ensures that no single response alternative will receive the level of support required to have a significant impact on the problem. Accordingly, ever increasing levels of effort result in an ever increasing growth in the range and scope of specific activities, but no major increase in the effectiveness of the effort as a whole.

6.0 EFFECTIVENESS OF THE EFFORT AS A WHOLE: ALTERNATIVE PERSPECTIVES

Slow but steady progress, or no progress at all? Expectations for the effectiveness of future efforts, if defined as increasing the scope and intensity of on-going activities, are guided by the past success or failure of similar initiatives. To the extent that efforts have produced a slow but steady reduction of the magnitude of the alcohol-crash problem, expansion of efforts implies continued progress. To the extent that past efforts have failed to produce results, however, gives rise to questions about why efforts have not been successful and whether or not increased effort will produce any benefit.

6.1 Preliminary Considerations

Estimates of the effectiveness of the effort as a whole are inexact because:

- o available data do not support unequivocal judgments;
- o aggregate data give rise to contrasting judgments about overall trends in traffic safety; and
- o how large the problem might have been in the absence of past and current levels of effort cannot be established.

Data describing patterns of alcohol use; characteristics of the licenced driver population; amounts of driving; amounts of driving under the influence of alcohol; the involvement of alcohol-impaired drivers in property damage, injury-producing and fatal crashes, are not adequate for definitive judgments of the effectiveness of efforts to date. Nevertheless, as Borkenstein (1979), Wilde (1976), Haight (1980) and others have observed, three persistent time-based trends are noteworthy:

- o the general tendency for total fatalities to increase over time;
- o the tendency for fatalities per kilometre to decrease steadily over time; and,

- o the tendency for fatalities per 100,000 population to remain constant over time.

Not surprisingly, differing judgments concerning the effectiveness of the effort as a whole arise, depending on which "trend" is considered. For example, as noted by Baldwin (1977):

Many factors have contributed over the years to the declining traffic death rate. It is easy for a discipline or an agency to claim credit by citing a change in program or level of activity, and then identifying on a time scale with a point on the death rate curve. Almost any event in the past 50 years could thus be shown as having been related to a downward trend in death rates. Unfortunately, a number of special interests have taken advantage of this opportunity. The resulting loss in credibility for all safety agencies has not eased the task of improving highway safety.

Of course, critics of countermeasure effectiveness have two other trends to rely upon: total fatalities which, with a few notable exceptions, have increased over time; and fatalities per 100,000 population, which have tended to remain constant.

It is worthy of note that, with some exceptions (e.g., Rockerbie 1980b), few claims of dramatic sustained success--or dramatic failure--appear in the literature. Rather, the general sentiment is that the problem has neither worsened nor improved. Whether this is interpreted as evidence of the effectiveness of the effort as a whole (in keeping the lid on the problem), or as evidence of failure depends, of course, on the predisposition and expectation of the evaluator.

Data summarized in Part One of this report indicate the experience over the past ten years in Canada.

- o Per capita consumption of alcohol has increased slightly (Figure 1).
- o Both the number of licenced drivers and the total number of kilometres travelled (VKT) have increased substantially (Figure 3,4).

- o The rate of drinking among drivers on the road has remained (essentially) unchanged (Interministerial Committee on Drinking Driving 1980; Lawson et al. 1982);
- o The number of drinking drivers on the road may have increased and the number of kilometres driven by drinking drivers may have increased.
- o The number of traffic deaths have fluctuated, with a substantial decline (1973-1976) followed by an increase (1977-1979) followed by another decrease, from 1979 (Figure 6).
- o Injuries due to traffic accidents, in contrast to fatalities, show a trend upwards (Figure 7).
- o The rate of "alcohol-involvement" in fatal traffic crashes (driver fatalities) has remained essentially constant.
- o Fatal traffic crashes (and fatalities) per 100 million VKT have declined (Figures 16 and 19).
- o Fatal traffic crashes (and fatalities) per 100,000 licenced drivers have also declined (Figures 13 and 21).
- o Alcohol-related fatal crashes per 100 million VKT may have decreased.
- o Alcohol-related fatalities per 100,000 licenced drivers may have decreased.
- o The number of driver fatalities, the number of those who had been drinking, and the number with BACs exceeding the legal limit, when subjected to time-series analysis, show no trend, either up or down (Beirness et al. 1984).

These findings provide little support either for success or for failure in the overall effort to reduce the magnitude of the alcohol-crash problem. Of course, lack of clear evidence of substantial reductions might be interpreted as "failure" (or, no effect). Conversely, absence of clear evidence of failure may be viewed as "success"--the lid remains on the problem!

6.2 "No Effect" or "Slow But Steady Progress"

The following discusses two alternative interpretations of the effectiveness of the effort to reduce the alcohol-crash problem: the "no-effect school" and the "slow-but-steady-progress" school. The Research Community figures prominently in the former and the Countermeasures Community in the latter. Given their propensity to publish their findings, researchers have perhaps promoted their "school of thought" more widely and successfully.

6.2.1 The no-effect school. Those accepting the "no-effect" hypothesis frequently cite such data as: the lack of change over time in the rate of alcohol-involvement in fatal traffic crashes (Warren et al. 1980); the lack of change over time in the rate of impairment among drivers on the road (Interministerial Committee on Drinking Driving 1980); the chronically high rate of alcohol-involvement in serious traffic crashes (Warren et al. 1980, 1981; Jones and Joscelyn 1979a); the evaluation of some 50 countermeasures (see Section 7.0), none of which seem capable of producing sustained reductions in the magnitude of the problem; or the short-lived effects associated with very great changes in the level of effort, for example, after "drunk-driving crackdowns".

The reasons cited for efforts having "no effect" include (1) an inadequate base of knowledge for countermeasure efforts and (2) unrealistic expectations stemming from an overemphasis on alcohol as a causal variable rather than as an indicator variable identifying groups of risk-taking drivers (Zylman 1974b, 1974c). This latter argument, which is related to the former, is particularly interesting.

Few, if any, would deny that alcohol impairment increases the likelihood of serious crash involvement. Many would argue, however, that alcohol impairment is neither a necessary nor a sufficient condition for collision occurrence. Consequently, rates of "alcohol-involvement" in serious traffic crashes exaggerate the actual contribution of alcohol impairment. Moreover, drivers with high BACs may comprise a group of

individuals who have a marked predisposition towards risk-taking. This characteristic--willingness to take excessive risks while driving--rather than alcohol impairment itself, may account for much of the overrepresentation of high BAC drivers in serious crashes (Zylman 1974a, 1974b, 1974c, 1975; Wilde 1981a; Simpson and Warren 1981; Smart 1969; Gilbert 1976; Crancer and Quiring 1970; Pocock and Landover 1980; McMurray 1970; Clay 1972; Pelz and Schuman 1974). Other evidence indicates that alcohol consumption itself can increase the tendency to take risks (Partanen 1981; Barry 1973).

The association between alcohol consumption and other behaviours (Gerson 1978; Gerson and Preston 1979; Bacon 1978; Eriksson 1982; Gussen 1971; Schmidt and Popham 1978) is consistent with hypotheses concerning risk-taking. Because behaviours resulting in traffic accidents, other types of accidents, suicides, homicides, and assaults, differ so greatly, the "involvement" of alcohol in them may indicate a subset of individuals who differ from the norm in terms of their overall patterns of risk-taking and other aggressive behaviours.

Returning to examples from traffic safety, alcohol-impaired drivers involved in serious collisions are more likely to have been driving at excessive speeds than are nondrinking drivers (Fell 1977; Terhune and Fell 1981). Alcohol-impaired drivers are also overrepresented among injured motorcyclists who did not wear helmets (McSwain 1981) and among drivers who did not wear seatbelts (Interministerial Committee on Drinking Driving 1980). Drivers who refuse to use restraint systems, particularly in jurisdictions where use is mandatory, are likely a high risk group--not only from a traffic safety perspective (Hurst 1980), but from other behavioural perspectives as well (Morgan 1967; von Buseck 1979).

Thus, some evidence supports the idea that personal characteristics and social circumstances--beyond impairment itself--account for the overrepresentation of high-BAC drivers in serious collisions. Consistent with this line of thinking, the higher a driver's BAC, the more likely such "risk-taking characteristics" are present. It should be noted that,

from the perspective of classical epistemology (Lakatos 1970), this alternative view is more acceptable than the more narrow theoretic formulation that underlies societal responses (driver impairment as a cause of crashes), inasmuch as:

- o it equally "explains" (i.e., results in predictions consistent with those of narrower formulations) the same phenomena;
- o it is equally consistent with existing empirical evidence;
- o it overcomes existing anomalies (impairment as neither a necessary nor a sufficient precondition to crashes) contraindicating the narrower model;
- o it applies to a broader range of phenomena (e.g., all traffic accidents rather than those specific to alcohol) and a broader range of alcohol-related damage; and,
- o it has an empirically validated excess content (i.e., there is empirical support for predictions precluded within the narrower framework).

Implications of the alternative paradigm are two-fold. First, even if countermeasures are successful in reducing substantially the frequency of driver impairment, the impact of this change upon actual crashes may be considerably less. Second, to the extent that driver impairment (high BAC) serves to identify a group of drivers who differ markedly from norms related to risk-taking, existing countermeasure strategies (which concentrate largely upon warning drivers about the risks involved, or deterring drivers by adding other risks (e.g., sanctions), are likely to have limited effectiveness. The possibility that such drivers may not respond to threat-based, risk-increasing measures has received comment by several authors (Wilde 1980; Bo 1978; Ross 1981; Homel 1980). As Bo (1978) observed:

Although Norway's present alcohol countermeasures do have an inhibiting influence, at least generally speaking, on the average non-accident driver, the facts show that those countermeasures are not at all effective against heavy drinking among accident-involved drivers. The

possibility thus exists that these drivers represent a high risk group, towards which another type of drinking-driving preventing measures may be necessary.

The implications of this observation are striking: Now that we have successfully coerced those least likely to have an alcohol-related road accident into behaving appropriately, let's turn our attention to others who, because of their personal characteristics, are most likely to have such accidents. To some, whose ultimate aim it is to decrease alcohol-related road accidents and associated losses, this might seem like a misallocation of limited resources. Scandinavian countries, however, simply have focused much more on deterring the antecedent behaviour (alcohol-impaired driving) than on preventing the loss-producing outcome (alcohol-caused road accidents). Hence, given the direct but very improbable relationship between the two problems, they have (in a sense) succeeded. Now, however, their work to reduce alcohol-involved road accidents begins. To produce substantial and sustained reductions in the magnitude of the problem, these countries (and, of course, almost all others as well) may have to shift radically their programmatic emphasis from deterring alcohol-impaired driving per se to the dealing effectively with drinking drivers most likely to have road accidents. This will require in-depth studies of the personal and social characteristics of high-risk target groups, particularly persons arrested and convicted for alcohol-related driving offences.

6.2.2 The slow-but-steady-progress school. Even if one accepts that the rate of alcohol involvement in fatal traffic crashes has not changed over the years, there are data to support the hypothesis of slow but steady progress. For example, per capita alcohol consumption has increased over time; thus, the observation that alcohol involvement in crashes has not increased is a sign of success. Changes in alcohol control policies have had adverse effects, increasing alcohol-related crashes (e.g., lowering the legal age for purchase of alcoholic beverages, increased availability, etc.) If alcohol-related fatalities have indeed remained constant, it may indicate that countervailing inroads have been made. Thus, there is some reason to believe that "slow but steady progress" has been achieved and that continued progress (no

increases in the problem) can be expected as long as increases in countermeasure resources keep pace with increases in those forces tending to exacerbate the problem.

6.3 Implications

Based on the foregoing, it is evident that the history of the overall effort to reduce the alcohol-crash problem has been, at best, a history of slow progress, and, at worst, a history of failure. Even the most positive assessments would not deny that the alcohol-crash problem still persists at an intolerable level, in spite of (or, irrespective of) a substantial countermeasure effort. Given the size of this effort (Hiland and Salter 1977), a newly emergent issue may relate not to the effectiveness of the effort as a whole, but rather to its cost-effectiveness, or lack thereof. Even optimistic estimates of the effectiveness of current and future alcohol countermeasures show that present approaches are a very costly route to loss reduction. For example, experts involved in traffic-safety programs estimated (in a Delphi-type exercise) costs and benefits of thirty-seven alternative countermeasures. "Combined alcohol safety action countermeasures" were ranked third in terms of loss reduction potential (estimated fatalities forestalled, 8,830), but eighteenth in terms of cost-effectiveness (dollars per fatality forestalled, \$242,000) (see Appendix One). These estimates proved overly optimistic: They greatly exceeded results obtained subsequently in the ASAP experience in the United States (Zador 1976, 1977; Reed 1981). Thus, to the extent that meaningful reductions are the aim of future efforts, serious questions must be raised regarding:

- o the level of increase in future efforts (compared to present efforts) required to prevent the problem from worsening;
- o the level of increase in future efforts (compared to present efforts) required to produce meaningful reductions in the absolute magnitude of the problem;
- o the likelihood that increases in present levels of effort will be considered socially and politically acceptable;

- o the cost-effectiveness of the effort as a whole as it presently stands;
- o whether each additional fatality prevented will prove increasingly costly (Haight 1980; Baker 1973); and
- o whether present efforts can be made more cost-effective than appears likely at present.

Given that available data provides only a rough approximation of the magnitude of the alcohol-crash problem over time, which hinders accurate assessments of past progress and future gains, a number of other questions should also be addressed:

- o the need for greatly improved data collection, monitoring, and surveillance systems; and
- o the need for international, comparative research on the alcohol-crash problem.

In sum, the issue becomes more than a question of the effectiveness or ineffectiveness of the overall effort, rather, how can it be improved? This question is discussed in Section 8.0 following a review of existing countermeasures and their impact in Section 7.0.

7.0 EXISTING COUNTERMEASURES REVISITED

Over several decades, many countermeasures have been introduced in response to the alcohol-crash problem; many more can be identified (Driessen and Bryk 1973; Raymond 1973). A corresponding number of reviews of countermeasures and their effectiveness have been published (e.g., Transport Canada 1964; USDOT 1969, 1970, 1979; USGAO 1979; Jones and Joscelyn 1979a; OECD 1978; West and Hore 1980; Raymond 1973; Ross 1981; Wilde 1974, 1981a; Zylman 1975; Cameron 1979; Edelman et al. 1977; Comptroller General 1979; Mosher 1980; Reed 1981; Moore and Gerstein 1981). The intent of this section is not to review countermeasures per se, but to examine the underlying theories of crash prevention from which countermeasures derive. It will be assumed that any program to reduce the alcohol-crash problem proceeds from some underlying theory about:

- o why people choose to drive while impaired (DWI);
- o why persons who choose to DWI have disproportionate rates of crash involvement; and
- o the relationship between the planned "intervention" and underlying "causal" relationships.

It will be argued that:

- o there are many "contending theories" about reducing the magnitude of the alcohol-crash problem;
- o these "contending theories" do not reflect a systematic, coordinated, integrated response to the alcohol-crash problem, but rather a series of largely independent, fractionalized attempts to deal with the problem;
- o these "contending theories" address only a limited range of the factors that contribute to the alcohol-crash problem;
- o the majority of these contending theories tend to be poorly explicated, limited in their applicability, and occasionally contradictory;

- o these theories are incapable of providing the guidance required to select optimal future courses of action, as none of them are capable of producing reliable loss-reduction predictions;
- o until these deficiencies are overcome, progress--defined either in terms of loss reduction or in terms of increased knowledge required for rational efforts to reduce losses--will likely be minimal.

7.1 Contending Theories of Alcohol-crash Prevention

Nine contending theories of alcohol-crash prevention will be considered, each of which consists of two components:

- o an "irrefutable core" (or "solution") aimed at eliminating some specific determinant of the alcohol-crash problem; and
- o an implicit series of linkages between desired outcomes and actions intended to achieve that end, in general, poorly articulated.

For example, "if no one ever consumed enough alcohol to impair the ability to drive, there would be no alcohol-crash problem". This is the irrefutable core of the "problem-drinker" paradigm, which seeks to reduce (or to eliminate) the frequency with which individuals consume alcohol in amounts considered hazardous when driving. It implies that "if there were no excessive alcohol consumption, there would be no impaired drivers; if there were no impaired drivers, there would be no alcohol-crash problem. The irrefutable core is a definitional truism and is not subject to question. The larger question, however, relates to how best to accomplish this objective (reduce "problem drinking"). This is expressed through a series of action-outcome linkages, or programs, designed to reduce excessive alcohol consumption. A related question concerns the determinants of the alcohol-crash problem to which this formulation applies. As the irrefutable core suggests, this paradigm focuses solely on a subset of behaviours occurring prior to the DWI decision itself. It focuses on the amount of alcohol consumed, rather than on other factors that may determine whether the person will decide

to drive (or refrain from driving) after having consumed alcohol and whether a DWI crash will occur. (The overwhelming majority of DWI trips do not result in crashes.)

Law-based, deterrent approaches proceed from the irrefutable core that "there is some level of disutility--a combination of the likelihood and the severity of punishment--at which all but the most fool-hardy individuals will refrain from DWI". This irrefutable core implies that it matters little how much people drink so long as they do not drive afterward. If everyone chose to refrain from driving after drinking, there would be no alcohol-crash problem. This, too, is a definitional truism. This paradigm concentrates on the decision to DWI (or to refrain). Factors influencing the frequency of "occasions for decision" (e.g., frequency of alcohol consumption; quantity of alcohol consumed) are addressed only tangentially. In other words, from the perspective of the deterrence paradigm, how much a person drinks, or how frequently, is irrelevant so long as he does not choose to drive afterwards. Programs based on deterrence consist of a set of action-outcomes linkages, linking specific measures such as random road-blocks or increased police surveillance to specific outcomes (e.g., real or perceived likelihood of arrest for DWI); and, in turn, linking these outcomes to frequency of DWI, and hence to alcohol-related crashes.

Nine of these contending theories are considered below. It would be unfair, perhaps, not to forewarn the reader that the purpose of this exercise is illustrative in nature. Because the underlying theories are, in general, poorly articulated (even chameleon-like in their characteristics), any attempt to rationalize them invites criticism. Nonetheless, because the point of the exercise is to illustrate these very deficiencies, failures in the task-at-hand might also constitute supporting evidence!

The "Problem-drinker" Treatment Paradigm: Reducing the alcohol-crash problem by reducing the frequency of excessive alcohol consumption (Filkins and Geller 1970; Filkins 1971; Waller and Turkel 1966; Waller 1967; Bacon 1978; Seixas and Hopson 1975; Brown et al. 1975; Sandler et

al. 1975; Hayslip et al. 1976; Jalazo et al. 1978; Kleinknecht 1969; Fine et al. 1975; Steer et al. 1978, 1979; Blumenthal and Ross 1975; Garrett 1981).

"If there were no excessive drinking (defined in terms "impairing" levels of alcohol consumption) there would be no alcohol-crash problem." This irrefutable core provides the basis for efforts related to the "rehabilitation" of alcohol-impaired drinkers. The central concern is "problem drinking" itself, so action programs normally fall within the venue of the "alcoholism" treatment agencies. Many reviews tend to define the scope of this effort narrowly--in terms of DWI offenders sentenced (or "referred") for treatment. However, consistent with the irrefutable core, virtually the whole alcoholism-treatment effort is of relevance to the alcohol-crash problem.

Theories of how to prevent excessive alcohol use abound within this larger theory of alcohol-abuse in relation to traffic safety. Previous reviews indicate that efforts directed towards the prevention of "problem drinking" or towards the rehabilitation of "problem drinkers" have had a notable lack of success (Bacon 1978). Of greater concern here is the paradigm concerning the relationship between excessive drinking and the alcohol-crash problem, and the range of behaviours to which it applies. This theory applies exclusively to the subset of the behaviours occurring prior to the decision whether or not to drive after drinking. The lower the frequency of excessive drinking, the lower the frequency of DWI. Unfortunately, the actual relationship is neither simple nor direct. Frequency of driving after drinking is a function not only of frequency of drinking, but also of other situational factors (e.g., where drinking is done, home or pub), environmental factors (e.g., levels of enforcement, road conditions, etc.) and, in particular, individual factors (e.g., willingness to take risks, knowledge or perceptions related to DWI and its consequences, etc.). Although the relationship between DWI and crashes is not addressed within this formulation, the relative contribution of impairment and other factors to the observed collision rates of "alcoholic" drivers are still subject to debate (Smart 1969; Waller 1969). Until this issue is resolved,

predicting loss-reductions from treatment programs will remain impossible.

Problem-driver Paradigm: Reducing the alcohol-crash problem by reducing frequency of DWI decisions, given the occasion for decision (Preusser et al. 1976; Vingilis et al. 1981; Malfetti and Simon 1975; Wendling and Kolodij 1977; McGuire 1975; Horowitz et al. 1981; Michelson 1979; Nichols 1981; Pennock and Poudrier 1978; South 1980; Stewart and Malfetti 1970; Swenson and Clay 1980; Swenson et al. 1981; Tiggs 1978; Ryan and Vasquez 1981b; Peck 1981).

"If drivers never engaged in risk-taking behaviours, there would be no traffic-crash problem." This irrefutable core treats the impaired driver no differently from other drivers who engage in other non-sanctioned risk-taking activities (e.g., those who drive at excessive speeds) with the exception that the program focuses on a specific risk behaviour--DWI. This approach focuses explicitly upon reducing the frequency with which persons decide to engage in risky activities. However, little is known about why individuals decide to DWI, or to refrain (assuming that some impaired persons actually refrain). Accordingly, theories regarding how to lower the frequency of such decisions are generally obscure and poorly grounded.

Efforts based on this approach emphasize "knowledge" and "attitudinal" change, for example, by providing emotion-based information about laws, punishments and other adverse outcomes associated with DWI decisions. The relationships between knowledge or attitudinal changes and the outcomes of interest (decisions not to DWI) remain poorly specified. Moreover, related programs usually make only limited attempts to influence the frequency of occasions for decision (frequency/quantity of drinking, especially in environments associated with a high probability of subsequent driving), and only indirect attempts to influence factors other than impairment contributing to the overrepresentation of impaired drivers in serious crashes.

Thus in the absence of more precisely defined operative linkages, it will be impossible to link successes, or failures, in loss reduction to specific components of the effort. If a program fails to achieve a measurable reduction, is this because the inappropriate information was provided, or because only individuals with the lowest risk were receptive?

Automotive-safety (Ergonomics) Paradigm: Reducing the alcohol-crash problem by removing the decision to DWI (Thompson et al. 1977; Tennant and Thompson 1973; Jones and Tennant 1973).

"If the decision whether or not to DWI were removed from the driver, there would be no impaired driving, and, therefore, no alcohol-crash problem." This paradigm addresses only the decision rate, with efforts focused on reducing it to zero by having a machine make the decision, not the individual. Consequently, it does not address elements germane to the alcohol-crash problem (occasion for decision, relationship between impairment and crashes). Solely at issue are the "theories-within-the-theory" regarding how best to accomplish the aim (e.g., self-administered impairment tests; automated driving performance monitors; etc.).

Because the explicit intent is to remove the latitude for decision from the impaired individual, the criteria for acceptability are imposing, as Thompson et al. (1977, p. 5-6) discussed:

- o large discrimination against intoxicated persons (positive rejection rates);
- o no discrimination against sober individuals capable of driving (false rejection rates);
- o high correlation with driving ability (if test is not alcohol-specific);
- o short duration of test;
- o rapid learning rate;
- o easy integration into vehicle;

- o insensitivity to age, sex, intelligence, and social or educational background;
- o not easily compromised (i.e., fool-proof and tamper-proof);
- o low cost.

This approach in the computer age is conceivable, but not likely in the foreseeable future.

Passive-technology Paradigm: Reducing alcohol-crash damage by reducing the likelihood or severity of crashes for impaired drivers (Baldwin 1977; Johnson 1981; IIHS 1981).

"If roadways and vehicles were so designed and built as to prevent alcohol-related crashes, or at least to protect from injury road users involved in alcohol-related crashes, then damage to people from these crashes would cease to be a problem". This irrefutable core accepts driver impairment as inevitable, and works to reduce the consequences (i.e., the likelihood or severity of outcomes) through passive and technological approaches. Information on why impaired drivers are more likely involved in serious collisions compared to other road users is sadly lacking, so theories-within-the-theory abound (i.e., regarding how to reduce the collisions of impaired drivers), yet these "theories" generally are not well grounded.

The major questions that must be addressed relate to the linkages between possible roadway improvements and loss-reduction. Until these relationships are specified, any such effort is destined to remain highly cost-inefficient. (One could well be making all the wrong changes for all the right reasons as easily as making all the right changes for all the wrong reasons.) In the area of vehicular safeguards, "passive" occupant restraint systems have received considerable attention as a loss-reduction mechanism, and by extension, a possible "solution" to the alcohol-crash problem.

The Public Information/Education Paradigm: Reducing the alcohol-crash problem through provision of knowledge required for "informed" deci-

sion-making (Calvert-Boyanowski and Boyanowski 1980; Burns and Moskowitz 1980; Farmer 1975; Haskins 1969; Finn 1975; Freedman and Rothman 1979; Griep 1970; Hames and Petrucelli 1981; Maas and Gluck 1981; Pierce et al. 1975; Robertson 1979; Transport Canada et al. 1973; Wilde 1974; Grey Advertising 1975; Mendelsohn 1973; Blaine and Hewitt 1977; Lauzon 1977; Marcoby 1980; Robbins and Hall 1970; Breslow and Fielding 1981; Colbourn and Baker 1973; Hochheimer 1981; Norstrom 1981b).

"Nobody willfully and knowingly would engage in behaviours that increased the likelihood that they or others would be killed or injured as a consequence of these behaviours." Based on this irrefutable core, this paradigm assumes that a rational, informed individual (i.e., aware of all the facts) would choose not to DWI, given its risks of accidental injury and death. This approach is directed specifically to the decision to DWI, and related indirectly to factors leading to occasions for such decisions (e.g., frequency of drinking, amount consumed, setting, etc.). Such efforts appear to result in improved knowledge and/or "attitude" (Farmer 1974; Griep 1970; Pierce et al. 1975). There is, however, little evidence (and, indeed, little reason to believe, given the largely unspecified linkages between the knowledge provided and the expected decisional and behavioural outcomes) that they produce the desired behavioural changes. Whether this is so only because the appropriate knowledge is not being provided (as suggested by the irrefutable core) is virtually impossible to ascertain in the absence of a more precise definition of action-outcome linkages.

Public informational programs in the area of drinking and driving have lost credibility as an effective measure (Griep 1970; Israelstam and Lambert 1977). It should be noted, however, that such efforts have produced results in other areas involving decision-making, human behaviour, and health outcomes, for example, concerning nutrition, fitness, obesity, and cancer risk (Marcoby 1980; Marcoby et al. 1977; Farquhar et al. 1977; Lauzon 1977; Hochheimer 1981). Recent public reactions to "toxic-shock syndrome", exploding pop-bottles, and unsanitary conditions at certain eating locations also indicate the potential for inroads through information and education.

It remains impossible, however, to predict good or poor results for informational programs because success and failure may depend not only on the appropriateness of the information provided, but also on many other factors. In other words, the program may fail even if the information provided is appropriate.

The Alcohol-availability Paradigm: Reducing the alcohol-crash problem by reducing the availability of alcohol (Schmidt and Popham 1978; Smart and Goodstadt 1977; Williams et al. 1981; Smith 1978; Smart 1979; Makela 1974; Brown et al. 1975; Gerson 1977; Beauchamp 1981a, 1981b; Frankel and Whitehead 1981; Wechsler 1980; Cook 1981; Vingilis and Smart 1981; Hauge and Irgens-Jensen 1981; Lacey et al. 1981).

"If there were no alcohol, there would be no alcohol-crash problem." Proceeding from this irrefutable core, the paradigm draws heavily upon a larger, more sophisticated, and reasonably formalized "distribution of consumption" model (Schmidt and Popham 1978; Parker and Harman 1978; Smart 1976). This model has spawned a broad base of research into the alcohol-crash problem, predominantly related to changes in "drinking age" laws (Schmidt and Kornaczewski 1975; Smart and Goodstadt 1977; Whitehead et al. 1974, 1975; Whitehead 1975; Wechsler 1980; Warren et al. 1977; Williams et al. 1975; Vingilis and Smart 1981); changes in the opening and closing times of bars, taverns, etc. (Smith 1978); liquor store strikes and their relationship to crashes (Hauge and Irgen-Jenson 1981; Smart 1977); and other aspects of availability (Smart 1979; Smart and Docherty 1976, Lacey et al. 1980).

This approach emphasizes reducing the frequency of occasions for deciding whether or not to drive after drinking, linking to reducing the frequency and quantity of alcohol consumed, linking to reducing alcohol's availability to consumers. The model deals with the proportion of individuals choosing to DWI (given occasion for decision), as well as the relationship between driver impairment and crashes, as constants. This approach limits its own application to traffic safety. For example, increased availability of alcohol may relate to impaired driving in

different ways. Increased availability may increase the frequency of drinking but reduce the frequency of DWI, if it becomes less necessary to use a car in order to visit a drinking establishment. Alternatively, increased availability may increase frequency of DWI to an even greater extent than implied by the frequency of consumption, if it tends to increase driving as well by adding possibilities for socializing. It is noteworthy that these relationships have not been examined adequately in studies of changes in the drinking age. Reductions in availability may increase alcohol-related crashes even if the overall frequency of DWI decreases. Persons most likely to drive large distances in order to drink, due to given decreased availability, are those most alcohol-dependent - the "alcoholic" driver, who may belong to a high-risk subset of problem drinking drivers.

Nonetheless, this approach is well-grounded theoretically (in comparison to other alternatives), encourages a steady growth in knowledge, and has resulted in accurate "predictions" relevant to public policy. Further definition of relationships among availability, consumption patterns, and resultant crash-damage should be considered a priority.

Removal of Driving Privileges: Reducing the alcohol-crash problem by removing the decision to drive (but leaving drinking unchanged) (Robinson 1979; Hagen 1978; Hagen et al. 1978, 1979, 1980; Peck 1981; Hurst 1980).

"If drunks cannot drive, they cannot crash." This irrefutable core underlies engineering efforts described in the Automotive Safety (Ergonomics) paradigm and efforts by licencing authorities and other agencies. It assumes, for example, that if a person's driving privilege is withdrawn (licence suspended or revoked, private automobile impounded) the number of "occasions for decision" (i.e., whether or not to drive after drinking) is reduced toward zero. Jail sentences also support this objective, at least during the time of incarceration. Programs based on licence suspensions and revocations appear to produce the desired outcome (Hagen et al. 1978, 1979, 1980). The effects of related measures, such as restricted driving permits, have yet to be evaluated.

Again, although such measures will work if programs actually do result in cessation of driving, the effectiveness of gradations in the above approach in reducing the frequency of DWI occasions is unknown. These measures address other components of the alcohol-crash problem indirectly, such as factors determining whether or not an impaired-driver with a suspended licence will crash (Hurst 1980; Warren 1982). The efficacy of these measures in reducing the alcohol-crash problem, therefore, remains unknown. It may be that the very individuals most likely to respond to such measures are those at the lowest risk of crash.

Sobering Remedies (And Other Alternatives to DWI): Reducing the alcohol-crash problem by increasing the possibility or desirability of non-DWI alternatives (Matilla 1981; Moskowitz and Sharma 1981; van der Brink and De Geer 1981; Hurst 1974; Transport Canada 1974; OECD 1978).

"If alternatives to DWI were more possible or less undesirable, or even beneficial, then the proportion of individuals choosing to DWI would rapidly diminish." Proceeding from this irrefutable core, a variety of imaginative alternatives to DWI have been discussed, albeit rarely implemented and even more rarely evaluated (Hurst 1973; Raymond 1973; Transport Canada 1974; OECD 1978). For example, "sobering remedies" (Van Der Bink and de Geer 1981) are, in the abstract, one such alternative. The mythical "sober pill" remains just that, a myth. Given alcohol consumption, time remains the only true sobering agent. Free bus transportation on New Year's Eve, free transportation home from bars and taverns, "buddy" driving systems, and other measures have been proposed. These approaches directly consider the human decisional elements of the problem itself. Unfortunately, they are not frequently used. The development and implementation these measures seems to require agencies or organizations willing to take that responsibility.

The decisional paradigms giving rise to these alternatives have not been researched thoroughly nor stated in formal terms. They do provide alternatives to more traditional approaches, which attempt to prevent alcohol-related crashes by making the decision to DWI less desirable without providing alternatives.

Enforcement and Punishment: Increasing the perceived and real risk (or disutility) of the decision to DWI (Homel 1980; Ross 1981; Hauge 1978; Joscelyn and Jones 1972; OECD 1974, 1978; Wilde 1981b; Zylman 1975; Birrell 1975; Blumenthal and Ross 1975; Borkenstein 1975, 1978, 1981; Bragg et al. 1979, 1981; Carr et al. 1974; Chambers et al. 1975; Clay and Swenson 1978; Council 1981; Cousins 1980; Ennis 1977; Harris et al. 1980; Havard 1975, 1979; Homel 1979; Hurst 1980; Kates et al. 1970; Noordzij 1979, 1981; Robertson et al. 1973; Robinson 1980; Rockerbie 1980a, 1980b; Ross 1973, 1975a, 1975b, 1978; Scrimgeour 1978a, 1979; Steenhuis 1979; Summers and Harris 1978; Summers et al. 1980; Surell 1979; van Oijen 1981; Vingilis and Salutin 1980; Hause and Voas 1982; Votey 1978; Waller et al. 1973; Warren 1977; Warren et al. 1977; Whitehead 1975; Wilde 1979; Wolfe 1980; Andreasson 1963; Bamark and Payne 1961; McGuire 1975; Williams and Robertson 1975; Vingilis, Adlaf, and Chung 1981; Dubowski 1981; Robinson 1981; Votey 1981; Cameron et al. 1981).

"There is a level of disutility--a combination of the likelihood and the severity of outcome--at which virtually everyone will desist from DWI, irrespective of the perceived alternatives." This irrefutable core constitutes the basis for massive deterrent efforts and reflects the basic approach characteristic of the overall effort to reduce alcohol-related crashes. Given the concentration of resources on this approach, it might be expected that linkages between various methods of deterrence, the actual or perceived risks achieved, and desired outcomes would be well documented and understood. This is not the case. As with other contending theories, the farther one moves from the irrefutable core, the more vague the linkages and the less reliable the predictions become. The literature on this subject is voluminous, and several reviews have been published (Homel 1980; Ross 1981; Ennis 1977; Hauge 1978; Havard 1979; Joscelyn and Jones 1972; OECD 1974, 1978; Summer and Harris 1978; Summer et al. 1980; Wilde 1981a). No attempt, therefore, is made to repeat this work.

A few observations, however, seem useful. First, relationships between objective and subjective risks of adverse outcomes and deterrence of DWI

are not well established. Second, because these relationships are not well established, and because the range of costs associated with available alternatives are unknown, it is almost impossible to estimate the extent to which the disutility of impaired driving must be increased in order to achieve meaningful reductions in the problem. Third, the greatest risk-takers (those most likely to become involved in crashes) may also be the ones least likely deterred. Fourth, the extent to which alcohol-related crashes are reduced by changes in levels of enforcement is uncertain (Zylman 1975).

Thus, in spite of a remarkable level of effort, along with an extensive literature on evaluations of this approach, it is difficult to determine why some "crackdowns" succeed, but most seem to fail (Hurst 1980; Waller et al. 1973; Ross 1981; Clay and Swenson 1978; Robertson et al. 1973; Vingilis 1980; Vingilis and Salutin 1980). Even in those instances where shortlived "successes" have been achieved, the effects vary greatly in their magnitude, and the reasons for this never have been researched (Ross 1981). Rather, these crucial linkages have been subject only to speculation, and this has resulted in many post hoc hypotheses, few of which have been tested empirically. For example, the substantial, three-year impact of efforts associated with the British Road Safety Act, could be attributable to:

- o the public's overestimate of the likelihood of arrest for impaired driving, or of the severity of sanctions;
- o the public's overestimate of the level of (night-time) enforcement, most affecting perhaps the driving behaviour of nonimpaired drivers;
- o A dramatic decrease in the perceived "social acceptability" of impaired driving as symbolized by the legislation, and the acute societal "determination" to resolve the problem; and
- o a dramatic increase in public awareness of the risks associated with traffic accidents.

Knowing which among these factors produced the desired effect is important so that they can be incorporated into new efforts. At

present, however, their relative importance is unknown.

The corresponding Canadian experience (1969) had lesser effects similar to the British Road Safety Act, and, reportedly, much more short-lived (Chambers et al. 1975; Carr et al. 1974, 1975; Warren 1977). The relative lack of impact of the Canadian initiative compared to that in Britain may have been due to the following factors:

- o inadequate publicity concerning the new measure;
- o inadequate enforcement, which failed to maintain initial levels of either actual or perceived likelihood of arrest for DWI;
- o initial court challenges particularly related to breath-testing, and failure to provide a sample, as evidence per se of an offense, which may have eroded the credibility of the deterrent;
- o limited initial enforcement capabilities, especially an inability to conduct roadside breath-testing; and
- o the countervailing effects of change in the age of majority and legal purchase age of alcoholic beverages.

Important questions remain unanswered, despite the widespread use of deterrent approaches and the reams of reports about them.

- o Why does this approach work (when it does)?
- o Why have programs based on this approach not produced greater, longer lasting results?
- o What can be done to achieve better results in future programs of this kind?
- o What can be done to prolong the impact of such programs?

Past efforts should have provided more concrete, useful insights than have emerged over past decades. Even for this best researched counter-measure paradigm, most of the crucial action-outcome relationships remain for investigation. Until this has been done, the effectiveness

of future enforcement/deterrent strategies will likely remain sub-optimal and highly cost-inefficient.

In sum, the "enforcement" paradigm, like those discussed earlier, consists of an irrefutable core and a largely obscure and ill-defined set of linkages between specific actions (e.g, levels of enforcement, severity of sanctions, certainty of punishment, etc.) and desired loss-reduction outcomes. To some extent, as will be discussed in Section 8.0, this is attributable to "zero-sum" evaluations, which tend to ask only "did it work or did it not" rather than "why did it work to the extent that it did".

7.2 Summary

Rather than a systematic, coordinated and integrated response to the alcohol-crash problem, there are many contending theories of alcohol-crash loss reduction. The majority of contending theories are poorly defined, limited in their applicability, and in terms of their irrefutable cores sometimes contradictory. These theories are rarely grounded in research-based knowledge about why persons choose to DWI, or why impaired drivers crash.

Each "theory" consists of a basic and irrefutable core, surrounded by a set of largely implicit (and often changeable) linkages. Consistent with its irrefutable core, each contending theory provides "guidance" regarding what should be done in order to reduce the alcohol-crash problem. None of the contending theories are capable of providing even crude loss-reduction predictions associated with specific actions, beyond the level of "more activity, greater results". Thus, there are not clear choices among these contending theories. To the extent that each addresses only a limited range of the phenomena of interest, many variables and conditions may intervene and thus make tenuous links between actions and loss-reductions. Because these theories are generally so poorly defined, and because they address only a narrow range of factors, continued growth of knowledge as a consequence of repeated programs is unlikely.

8.0 EVALUATION: THE ELUSIVE MISSING LINK

In Section 5.0, the Alcohol Safety Community was described in terms of a "two-communities model". In that model, the Research Community and the Countermeasures Community represent generally distinct groups of people, agencies, or organizations and serve different functions. In Sections 6.0 and 7.0, issues related to the effectiveness of countermeasures and the rational basis of countermeasures were discussed. These sections also identified grounds for contention between Research and Countermeasures Communities and illustrate how, despite a common goal, the communities can stand in opposition to each other.

Evaluation, the subject of this section, can also appear divisive and, in practice, counterproductive. It need not be either. Of all lessons from the past, those related to evaluation seem most thoroughly learned and least applied. Of the many options for the future, those involving evaluation seem most attractive. In fact, the function and role of evaluation represents a vital--and missing--link between research and action programs.

In the context of dealing with drinking-driving problems, then, this section identifies issues surrounding evaluation and makes a case for a broader concept of evaluation. Neither the issues nor the concept of evaluation are new. Both the issues and the concept do deserve fresh consideration, if only because evaluation offers common ground to all with the shared objective of reducing the alcohol-crash problem.

8.1 Program Evaluation

Evaluation is often considered at the level of programs, which are structured efforts to accomplish one or more objectives. Programs in the area of drinking and driving have as their ultimate aim reducing the alcohol-crash problem. As discussed in Section 7.0, programs employ certain strategies and tactics based on countermeasure approaches. Specific aims and objectives often relate to drinking-driving problems

in part, not as a whole. Program evaluations, therefore, relate directly to those specific aims and objectives.

The effects of the program on the overall objective of reducing alcohol-crash losses, however, do have relevance. For example, it would be important to know whether a program with specific aims consistent with its approach produced the desired effect and also increased the magnitude of the problem. This is not as far-fetched as it may seem. For example, common wisdom has it that increasing penalties for alcohol-related driving offences will (1) deter people from committing those offences and, when meted out to offenders, (2) will reduce the likelihood of repeat offences. Ross (1981) summarized evidence that deterrence programs have not been as effective as hoped. Homel (1980) has shown that more severe penalties are actually associated with an increased likelihood of repeat offences among certain offender groups. The role of program evaluation, therefore, is to provide information that puts common wisdom to the test.

Program evaluations also relate to the fundamental soundness of counter-measure approaches and to the linkages between actions taken and results produced. The following section, therefore, discusses program evaluation in terms of theory, consistent with Section 7.0.

8.1.1 Program evaluation from a theoretical perspective. Each program implies an hypothesis (or set of hypotheses) derived from some underlying theory about impaired driving and its consequences. That is, if we do "x", "y" will result (Norstrom 1981a). Accordingly, each program evaluation can be considered a test of one or more hypotheses of the theory. The observed "impact" of the intervention, therefore, constitutes a test of the theory itself. When the observed results of the "experiment" (actual program) are in accord with the predicted results (derived from theory), this provides support for the theory. Negative results (failure to achieve the predicted outcome) can also contribute to the advancement of knowledge, as they encourage critical reassessment of the underlying theory. For example, if predictions

based on theory are at variance with observed results (e.g., the predicted effect was not achieved), then the theory must be revised to render the predictions more consistent with actual experience--or the theory must be abandoned altogether. Thus, each evaluation program can and should result in better knowledge about the action-outcome linkages included in the theory.

Specific to the alcohol-crash problem and efforts to deal with it, the following can be asserted:

- o Each impaired-driving intervention program reflects some underlying theory regarding impaired driving and its consequences.
- o Each evaluation becomes a test (or experiment) designed to assess not only the effectiveness of the program itself, but also the adequacy of the theory on which the program is based.
- o The results of an evaluation not only measure the effectiveness of the program itself, but also indicate the adequacy of the theory.
- o The results of an evaluation not only indicate whether or not to retain the program, but also whether or not to revise (or to reject) the theory.
- o Successive program evaluations can result in progressively more adequate theories about the phenomena addressed by the theory (impaired driving and its consequences).
- o Ongoing refinements in theory lead to better predictions about the impact of alternative intervention programs.
- o Successive evaluations also lead to increased understanding of the problem itself and of what must be done in order to effect meaningful reductions.

Thus, following a classic "cumulative-growth-in-knowledge" approach, it would be expected that, based on its evaluation of programs, the Alcohol Safety Community would be able to provide increasingly refined guidance

to the decision-maker about what must be done to achieve meaningful reductions in the magnitude of the problem and how to produce desired results. Theoretical frameworks of thought, however, often vary greatly from practical experience. For evaluation in general, and program evaluation in specific, this is also the case.

8.1.2 Theory in practice. After several decades of countermeasure experience internationally, little is known about what should be done in the future in order to achieve meaningful reductions in the alcohol-crash problem. This can be attributed in part to a widespread misconception of the role of program evaluation.

Program evaluation includes (1) outcome evaluation and (2) process (or administrative) evaluation (Griffin et al. 1975; Tarrant and Veigel 1977; RTAC 1981). Any overemphasis on ultimate outcomes (e.g., accidental injury) is understandable, being the general aim of the program. It is also unfortunate. Overemphasizing ultimate outcomes reduces the conduct of evaluation to a zero-sum ("all or nothing") exercise: either the program "succeeded" and should be retained, or "failed" and should be abandoned. Rarely does it contribute to development of an improved knowledge base regarding why a program failed, why a program succeeded to the extent it did, or why a program did not succeed to a greater extent.

For example, the question of who was affected by the program, and who was not is addressed only rarely (e.g., Ross 1973). The question of why a program was not effective for specific groups is virtually never addressed but remains subject to speculation (Ross 1973; Carr et al. 1974; Chambers et al. 1975; Warren 1975; Norstrom 1981b). "Impaired drivers" are not a homogeneous group and any given countermeasure affecting only a subset of these individuals is likely to have only limited success (Homel 1980; Hagen et al. 1980; Stewart and Malfetti 1970; Bo 1978; Kule and Watman 1971; Warren 1976). To assess the impact of a countermeasure only in terms of behaviour (impaired driving) rather than on impaired drivers adds little to knowledge. This is also true of comparative evaluations, ones that assess whether Countermeasure A is

"more effective" than Countermeasure B. Both countermeasures might well be effective, but for different groups of impaired drivers (Hagen et al. 1978, 1979; Ryan and Vasquez 1981a; Peck 1981; Homel 1980; Blumenthal and Ross 1975).

If responses to the alcohol-impaired driving problem are to become increasingly refined and increasingly cost-effective, far more comprehensive evaluations than presently done are needed: evaluations that focus less on whether a program succeeded or failed, and more on what elements of a program were successful or unsuccessful in relation to whom, and why.

The issue here is why comprehensive, informative evaluations--"positive sum" evaluations--are the exception to the rule. The existence of the two separate, often opposing, communities, Research and Countermeasures, is one reason. Further, the traditional reliance on zero-sum evaluations has increased divisions and hindered acceptance of a broader concept and expanded role for evaluation in general.

8.1.3 Zero-sum evaluations as a barrier between Research and Countermeasure Communities. A narrow concept of evaluation held by researchers leads to the notion of "countermeasure-as-experiment". The intent of the "experiment" is to determine whether the experiment was a success. Unfortunately, this concept, "countermeasure as experiment", runs contrary to a very important goal of programs for the Countermeasures Community: implementation. The major need for justification of a new countermeasure arises before the measure is implemented. This may even apply to expanding existing countermeasure activities. Normally, members of the Countermeasures Community must compete vigorously with others inside and outside the road-safety and alcohol-health areas for a very limited pool of resources.

To implement a program--given social, political, and economic considerations--requires convincing the decision-maker that the program will work. For example, it is politically unacceptable to justify implementing large-scale programs as "social experiments", particularly programs

that "impose visible costs upon the citizenry" (Rose 1976). The only defensible position is that there is a high degree of certainly that the measure will succeed. This, of course, is largely incompatible with informing the decision-maker that there is a need to determine whether or not the program did succeed. This latter position is an admission that the program may fail and greatly weakens the case for, and probability of, its implementation. Of course, one can always justify evaluation as a means to "demonstrate" the wisdom of having introduced the program. Nevertheless, careful evaluations may be costly and may even cost more than the program itself. It is difficult to justify spending so much to demonstrate that it worked when in fact a carefully done evaluation could "demonstrate" just the opposite! Thus, despite continued demands from the research community (e.g., Jones and Joscelyn 1979a), the number of evaluations remains low. Those that are conducted tend to be "quick and cheap" (and zero-sum) rather than in-depth and comprehensive.

Beyond the unattractive notion of countermeasure-as-experiment, another factor impedes the conduct of program evaluations: lack of expertise. Few members of the Research Community are involved directly in the development and implementation of programs; few members of the Countermeasures Community are trained in research, even though many may concern themselves with setting research priorities. The limited involvement of the Research Community in the development and implementation of programs has unfortunate ramifications for program evaluations.

Over the years, many experts have recommended that sophisticated evaluation plans be incorporated into the design of new programs. Evaluation as a discipline still remains largely the province of "researchers". As suggested, however, programs experts rarely are trained researchers. Even if a countermeasures agency has the expertise, agencies evaluating their own programs are always held suspect, and, justifiably or not, are subjected to questions of "independence", "objectivity" and "conflict of interest". From where, then, does this expertise come? This is a particularly salient issue because the Research Community tends to have only a limited involvement, and perhaps, limited expertise or interest,

in program development and implementation. Due to its limited implementation, due to its limited involvement, the Research Community cannot contribute its expertise in program evaluation, and pre-conditions for comprehensive, non-zero-sum evaluations rarely exist. Thus the causal mechanisms through which program activities become measured effects are rarely made explicit. The underlying theory regarding why people drink and drive, and the associated theory of how specific program activities will affect or modify predicted outcomes, normally must be inferred by researchers after program implementation (Norstrom 1981a). The adequacy of these post hoc inferences is open to question. Accordingly, the researcher often avoids detailed examination of causal mechanisms and concentrates instead on less contentious measures of outcomes. Other preconditions for comprehensive evaluation are also frequently absent as well. For example, inadequate pre-implementation base-rates and changing program characteristics hinder attempts at meaningful evaluation.

Zero-sum evaluations contribute little to the shared goals of either the Research Community or the Countermeasures Community. Zero-sum evaluations polarize relationships between the communities rather than enhancing opportunities to work together. For example, rather than working together with available knowledge to achieve successive program improvements and refinements, the Countermeasures Community becomes "accountable" to the research community for program results. When negative results might lead to a program's abandonment, the researcher assumes as much the role of threat as the role of ally. This is exacerbated further by the most fundamental characteristic of research: the nature of research tends to make researchers uncomfortable or unwilling to provide unequivocal recommendations to policymakers concerning decisions that relate to program retention or abandonment--the results of social research in real-world settings are almost always inconclusive!

Again, in theory, scientific research--not necessarily evaluation itself--proceeds from what may be termed a "negative heuristic"--it can prove nothing, it can only fail to "disprove" (Popper 1963; Kuhn 1970; Lakatos 1970). Thus, ultimately, research cannot prove that a program

succeeded or failed. A researcher can "fail to refute the hypothesis that a program had no effect", but one cannot conclude from this that the program had no effect. Similarly, the researcher can fail to refute the hypothesis that a program had an effect. However, this is still not sufficient to conclude that a program had an effect, unless all other "competing" (or "alternative") hypotheses, which also might explain the effect, have also been refuted. In the real world, this often seems very difficult if not impossible.

Thus, in terms of decisions to retain or to abandon a program, the results of zero-sum evaluations are always "inconclusive". In this way, zero-sum evaluations become a barrier between Research and Countermeasure Communities. First, such evaluations have resulted in increasing conflict between the Research and Countermeasures Communities and a progressive discrediting of the efforts of both. Second, zero-sum evaluations have led to reliance on a negative approach to improvement in knowledge about how to deal with the impaired-driving problem in the future.

8.2 Evaluation as an Issue

The tendency to conduct zero-sum evaluations (and the inconclusiveness of research results) has had unfortunate consequences both for the relationship between the Research and Countermeasures Communities and for the credibility of the alcohol-safety effort as a whole. Because zero-sum evaluations may threaten program survival, criticism and the growth of knowledge turn into a process of "mutual discrediting". This holds for "favourable" evaluation outcomes. As Voas (1981b) noted:

As always, after each of us had presented a countermeasure, or several countermeasures and carefully marshalled our evidence, there are always one or two who would get up and damn all the evidence, and bring us all to task for not being more careful or effective in our evaluations, and we had our critics...(p. 1460).

Unfavourable results of evaluations occasion stronger reactions, mostly because they threaten the credibility of a program. In an article entitled, "a note on neutralizing strategies in response to unfavourable evaluation research findings", Roizen isolated nine common tactics:

- o Challenge the occasion (i.e., argue that program workers (PWS) have not had sufficient time to read the report, are inadequately represented, etc.).
- o Challenge the viability of releasing the report (i.e., research results are inconclusive, and negative findings will be misinterpreted or sensationalized by the press).
- o Downgrade the status of the report (because it is not "conclusive", it should be termed "preliminary" or interim, etc.).
- o Argue that the "true" program was not evaluated.
- o Argue that the program was effective, but the level of effort or funding was too low.
- o Argue that "other approaches don't work either" and "we've got to do something".
- o Argue that the original approach of the program requires modification (program-enhancing changes).
- o Argue that the program was successful on outcome dimensions not considered by the research study.
- o Argue that the researchers were incompetent or biased (i.e., the program had an effect, but the researchers were incompetent to find it, or unwilling to acknowledge it).

This latter response, aimed at discrediting the study or the researchers themselves, seems most counterproductive. Unfortunately, it can be appropriate. Research does have a certain bias against program effectiveness--the usual criteria for proof are set exceedingly high. Such criteria become difficult to meet in conducting research in "real-world settings". Problems encountered include inadequate control groups, bias

by selection (or self-selection), inappropriate measures, limited accessibility of study population, limited control over subject assignment, limited control of external conditions, poor quality data, missing data, and nonrespondent bias. Concerns of the Countermeasures Community therefore--that the program had an effect and the evaluator failed to detect it, or that the evaluation had an implicit "bias" against the program--may at times have some validity. This is, of course, particularly true in the case of small, inadequately funded programs, where the expected effects are at best likely to be small and difficult to measure empirically.

The other concerns (or, "tactics") of the Countermeasures Community articulated by Roizen also have some validity. Moreover, the very fact that these issues are raised reflects the absence of communication between the two communities, borne of feelings of mutual mistrust and, at the extreme, hostility.

In summary, zero-sum evaluations have had negative consequences as a divisive issue. It has led to a general entrenchment of positions and a generalized unwillingness to "accept" evaluation results as one means to progress. Most unfortunate, however, is that it has resulted in increasing attempts to discredit the efforts of the research community, based on the general "inconclusiveness" of results, a misplaced emphasis upon the deficiencies of the research study, and an increasing tendency to ignore more meaningful results. Accordingly, "unfavourable" evaluation outcomes lend themselves readily to two alternative interpretations:

- o the program was not effective; or
- o the program was effective, but the evaluation or the evaluator failed to detect it.

Interpretations by the Countermeasures Community, of course, tend to be the latter. Proceeding from a consideration of the limitations and deficiencies of the evaluation, programs experts argue that the results

are inconclusive, and therefore, abandonment of the program would be both premature and unwise.

8.3 Examples of Evaluation at Issue

It is a source of considerable frustration to the research community that old programs continue to survive and expand and that new, untested countermeasures continue to arise, despite the fact that "no countermeasure has been demonstrated to produce a sustained reduction in the alcohol-crash problem" (Zylman 1975; McLean 1979; Simpson 1977; Jones and Joscelyn 1979a; Norstrom 1981b).

For example, Norstrom (1981b) addressed the question of why informational campaigns on DWI continue to appear in spite of their ineffectiveness. Reporting the results of a "deleterious" evaluation, Norstrom notes that, "fully aware of the (negative) findings presented in this paper, TSV launched another campaign against drunken driving in 1979" (p. 1243). Norstrom attributed the apparent insensitivity of TSV, which was unresponsive to the negative results of evaluation, to "organizational inertia", among other factors. Two additional factors may also have lead to that outcome. First, of course, is the notion that research results are, of necessity, inconclusive. Second, and perhaps more important, is the notion (advanced in Section 7.0), that each program proceeds from an irrefutable core, in this case, "that informational campaigns can achieve significant inroads into the impaired-driving problem", and "that the failure of one information program does not mean that the principle (irrefutable core) is invalid". Rather, a "new, improved" program might well succeed where its predecessor has failed.

Thus, even if one accepts the finding that a given informational campaign failed to produce a reduction in DWI or alcohol-related crashes, this only demonstrates that the methods used in that campaign did not produce the desired behavioral outcomes. The premise that informational programs can produce meaningful reductions in the alcohol-crash problem still stands. Accordingly, a negative evaluation need not result in the

abandonment of either the program or the underlying paradigm itself. Rather, the negative results of an evaluation could also produce an expansion of the program, the simple hypothesis being that a larger scale effort is needed to achieve the desired outcomes. It becomes readily apparent that no evaluation is construed as having generality, as every program (even within a specific response modality) is different. Even if a program is abandoned on the basis of a negative evaluation (presuming this has happened), there are no shortage of programs to take its place, because a great number of alternative programs exist (more enforcement, better videos, larger target population, slightly different information, new acronym, etc.).

A similar analysis could be made of a program dealing with alcohol-impaired driving in Ontario. The random-stop enforcement program R.I.D.E. (Reduce Impaired Driving Everywhere) has continued to expand in spite of evaluations that are uniformly described as "inconclusive" (Vingilis et al. 1981; Vingilis and Salutin 1980).

Ironically, the best example of evaluation at issue is the U.S. Department of Transportation's Alcohol Safety Action Project (ASAP). The irony stems from the large evaluation components built into this nationwide, multi-faceted thrust at drinking-driving problems, the design of which led to critical (and generally) negative evaluations by some experts (e.g., Zador 1976). Even before the final outcomes of ASAP activities were known, a debate began between the Countermeasures Community (U.S. Department of Transportation 1975; Johnson, Levy, and Voas 1976) and the Research Community (Zador 1977). Although the overall effectiveness of ASAP was also in question, the pivotal issue was how and how rigorously to evaluate results of ASAP.

High-school driver education (HSDE) programs offer another example of evaluation at issue. Unfavourable results of evaluation (IIHS 1981) have not greatly lessened support of this road-safety measure. The familiar refrain, "there is no conclusive evidence that high school driver education (HSDE) produces safer drivers" (e.g., Page-Valin, Simpson, and Warren 1977) produced equally familiar counterclaims from

the Countermeasures Community that these studies were "inconclusive", and that "a quality HSDE program is capable of a 10-15 percent... reduction in the probability of crash involvement among persons exposed to it" (USDOT 1977). Evaluations have not (yet) resulted in abandonment of the effort or even a fundamental paradigmatic shift. Recently, even more unfavourable results (Robertson and Zador 1977; Robertson 1980) have led to explicit demands for the elimination of HSDE. Not surprisingly, the response of the Countermeasures Community was swift, substantial, and vitriolic. Not only were the results dismissed as inconclusive, based on questionable methodology, etc., even the motives of the researchers were impugned (e.g., Cushman 1977). Finally, advocates of HSDE have tended to look to the "DeKalb Driver Education Project" as a conclusive demonstration of the effectiveness of driver education. This appears very unlikely. The DeKalb study, like all other studies, cannot be conclusive--it will have limitations. Irrespective of the outcomes of that study, high school driver education can be expected to continue, largely unchanged.

8.4 Resolving the Issue of Evaluation: A Broader Concept of Evaluation in Relation to Action and Research

Although the U.S. Alcohol Safety Action Project's precipitate launching and conduct were appropriate to the program's acronym, ASAP nonetheless proved a watershed for evaluation. In this context, Jones and Joscelyn (1979a) discussed in some detail the history, design, plans, and programs of ASAP. They did so in terms of the systems approach. The "systems approach" is based on the premise that dealing with a problem as a whole is more effective than dealing with its parts separately. Their discussion of the systems approach and their objective review of the ASAP experience deserve careful reading. In particular, they provided an insightful analysis of the issue of evaluation, which they termed a "key ingredient to future progress in alcohol-safety". In keeping with the nature of this report--a resource document--an excerpt from their chapter entitled "Future Directions of the Alcohol-crash Problem" is reproduced below. It represents a milestone in thinking about evaluation in relation to drinking-driving programs just as ASAP

represents a monument to (or, in the minds of some, perhaps a tombstone for) large-scale, mega-buck, countermeasure initiatives.

Evaluation of both new and on-going programs is a key ingredient to future progress in alcohol-safety. Without it, past misconceptions and mistakes will be perpetuated; with it, successful techniques can be identified, further improved, and diffused to other users.

There are few examples of careful evaluations of alcohol-safety programs before ASAP. When programs or "counter-measures" were evaluated, this was done with rigor insufficient to provide a reliable basis for decision making on future programs. ASAP's great contribution to the field of alcohol safety was to test and evaluate on a large scale and for the first time many widely held hypotheses about how to decrease alcohol-related crash losses.

Even so, ASAP has fallen short of meeting what some evaluation specialists believe are minimal requirements for evaluating social programs. These evaluators believe that nothing short of rigorous experimental design methodologies such as those used in a laboratory setting will provide scientifically acceptable evidence of the success or failure of a program. Inevitably, this requires the use of a "control" group which matches the "treatment" group in every significant respect except exposure to the countermeasure.

Critics of the use of control groups for evaluating social experiments argue that it is virtually impossible to define a control group that matches the treatment group so completely. They favor so-called "quasi-experimental designs," such as time series analysis, that examine the fluctuations of crash rates and other pertinent variables over suitably long periods of time both before and after the introduction of the alcohol-safety program.

A more recent school of thought rejects both the rigorously experimental and quasi-experimental approaches as impractical and unrealistic. Experimental research as a method for evaluating complex societal programs is viewed as largely irrelevant to real world needs, often leading to unwarranted rejections of programs whose effects cannot be proved statistically "significant." What is needed, it is claimed, is a way of organizing and presenting information that will best support the practical needs of decision-makers (Edwards, Guttentag, and Snapper 1975). The science of decision theory is offered as a means of achieving this end.

Thus, though evaluation is essential to improving programmatic responses to the alcohol-crash problem, no one knows for sure how it should be conducted. In the near-term future, careful application of time-series analysis techniques seems the most practicable approach. At the same time, program designers and managers should be aware that the art of evaluation is still developing. Evaluation methodology "cults" that claim to provide sure-fire answers that exclude other approaches, and that defy common sense, should be avoided. Research and testing of innovative approaches (including decision theoretic approaches) should be strongly supported.

Finally, it is critical that the results of evaluations be carefully and thoughtfully analyzed before deciding on the worth of alcohol-safety programs. Past experience indicates that progress in dealing with the alcohol-crash problem will not come easily and that even relatively large expenditures of resources will often fail to produce an effect that can unequivocally be attributed to the programs. In many cases, effects that seem to be the result of a particular program will be disappointingly small and appear to be unworthy of the effort. Before rejecting such a program as "ineffective," one's original expectations should be critically reexamined to see if they were compatible with the enormous complexity of the problem and with the limited knowledge and technology available to deal with that problem. (Jones and Joscelyn 1979a, pp. 184-185)

Although many questions about evaluation remain unanswered, one issue seems ready for resolution. The issue has to do with evaluation as a component, or element, in the overall social response to the alcohol-crash problem.

It was observed at the beginning of this section that "evaluation...can appear divisive and, in practice, counterproductive" and that "it need not be either". Actual examples of program evaluations illustrate the former statement; theory and formulations support the latter assertion. For example, in Section 8.1.3, evaluations, particularly zero-sum evaluations, were discussed as a barrier between the Research Community and Countermeasures Community. In contrast, Jones and Joscelyn (1979a) offer a compelling though dispassionate argument for evaluation as an activity beneficial to both research and programs. In light of past experience, it seems that evaluation is a good idea whose time has yet to come.

Perhaps the issue to address first is neither whether to evaluate or not, nor even how to evaluate, but rather the function and role of evaluation in relation to both research and countermeasures. Members of both Research and Countermeasures Communities accept (at least in the abstract) that evaluations done competently, objectively, comprehensively, and appropriately support their distinct aims and objectives. Managers need to know whether their programs have been implemented according to plan and have produced desired results. Researchers, in their efforts to advance practical knowledge, need to have their theories and hypotheses tested in the real world, where the problem occurs. It may be, after all, that ownership of evaluation is the real bone of contention. If researchers--with their expertise, their familiarity with experimental designs and statistical tests, and their scientific outlook--"own" evaluation, then managers of programs might well feel threatened. A research-based evaluation is likely to prove nothing but trouble. If, on the other hand, managers--with their commitment to action, their hands-on experience with real-world constraints, and their pragmatic outlook--"own" evaluation, then researchers might well be highly skeptical. An action-oriented evaluation concerned more with implementation than results is likely to prove that the program should continue, perhaps (as a sop to critics) slightly modified. This polar perspective itself is part of the problem. The adversarial relationship between Research and Countermeasures Communities concerning evaluation--which is real, not imagined--would seem absurdly funny if it were not so devastating to the evolution of the social response to deaths, injuries, and other losses due to alcohol-related road accidents.

To resolve this issue, we have to accept that evaluation belongs neither to the Research Community nor to the Countermeasures Community. In other words, we must broaden the concept of evaluation beyond "evaluation as program component" and "evaluation as research activity". In fact, we have to broaden our concepts of research and countermeasures (or, better, action) as well. The broader concept of evaluation, research, and action would treat each as functions, not activities. An analogy might serve to elucidate this point. The heart's function in

the body is to circulate the blood; its activity is regular, coordinated muscular contraction.

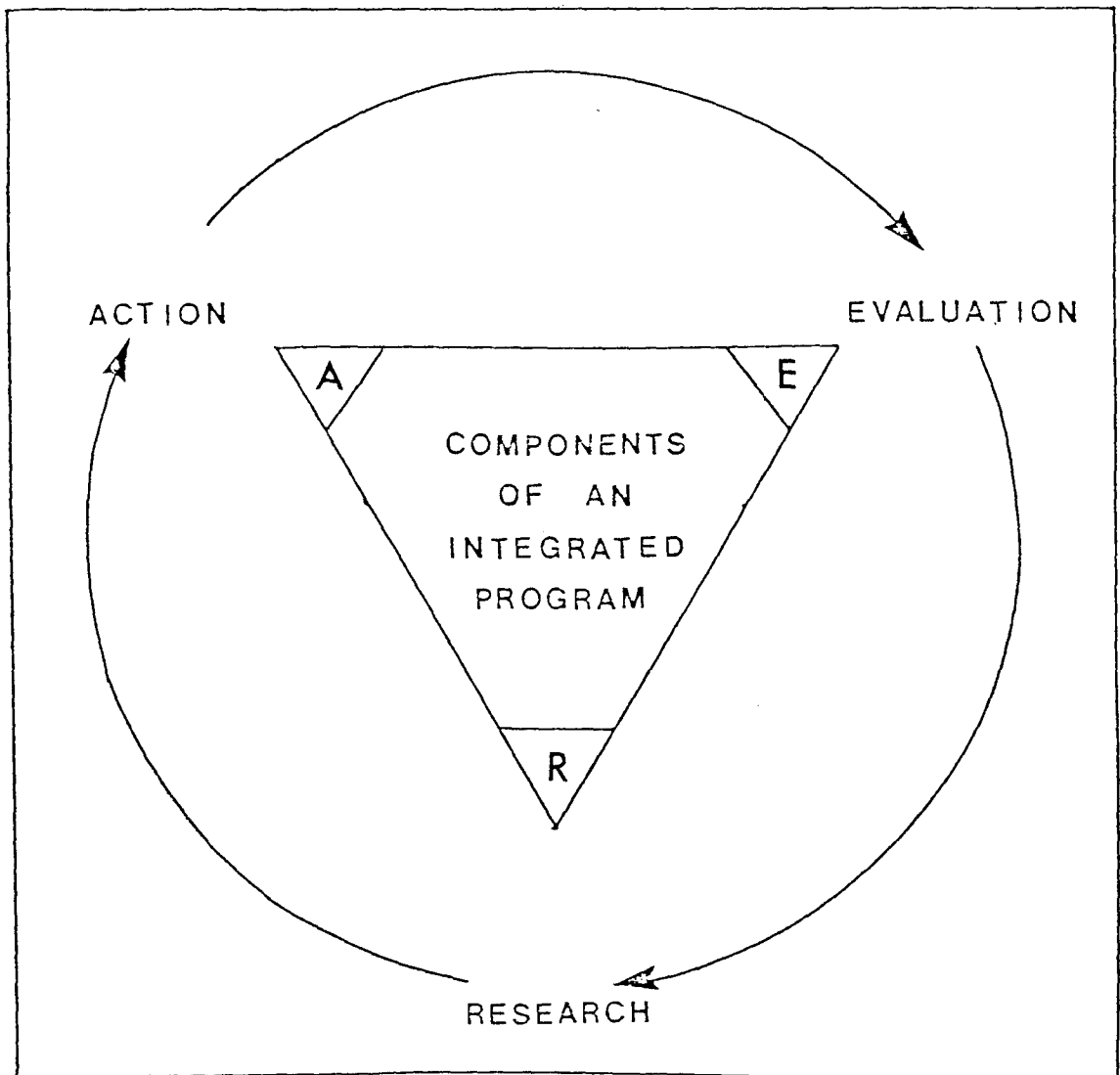
Briefly, then, the function of evaluation is to generate information about the implementation of action programs and about their effect and their effectiveness in achieving explicit goals and objectives. The function of research is to define the problem and to communicate knowledge-based information to key actors and stakeholders in the field. The function of action is to implement programs designed to reduce the problem. The activities associated with each function are numerous, diverse--and also interrelated.

In fact, Research, Action, and Evaluation represent three distinct yet integral functions in the overall effort to reduce alcohol-crash losses. Each component relates to the other two in a complementary fashion, as shown in Figure 30. Together these components represent a continuous, iterative process at the level of programs. This conceptual framework offers a way of thinking about research, action, and evaluation that rises above "territorial imperatives", "turf building", and other counterproductive activities engaged in by many in this field.

Figure 31 elaborates the framework and defines the relationships between the three components. It also adds a fourth, critical element: policy. In the absence of an explicit policy that establishes and maintains the iterative process illustrated in Figure 30, it is highly unlikely an integrated program with functional components--action, evaluation, and research--will operate in the real world. Moreover, without such a policy, the activities of program evaluation, hypothesis testing, and program development will continue as they have to date: fragmented, uncoordinated, and, too often, counterproductive. The result will be that the effort as a whole will produce results far less, and far less cost-effectively, than the sum of its parts would promise.

The principle of evaluation as function, not activity, represents the missing link that should dissolve barriers between Research and Counter-measures Communities--if the three-component model is established by decision-makers as policy, and if three-component integrated programs

FIGURE 30
A MODEL
INTEGRATING ACTION, RESEARCH, AND EVALUATION
FUNCTIONS

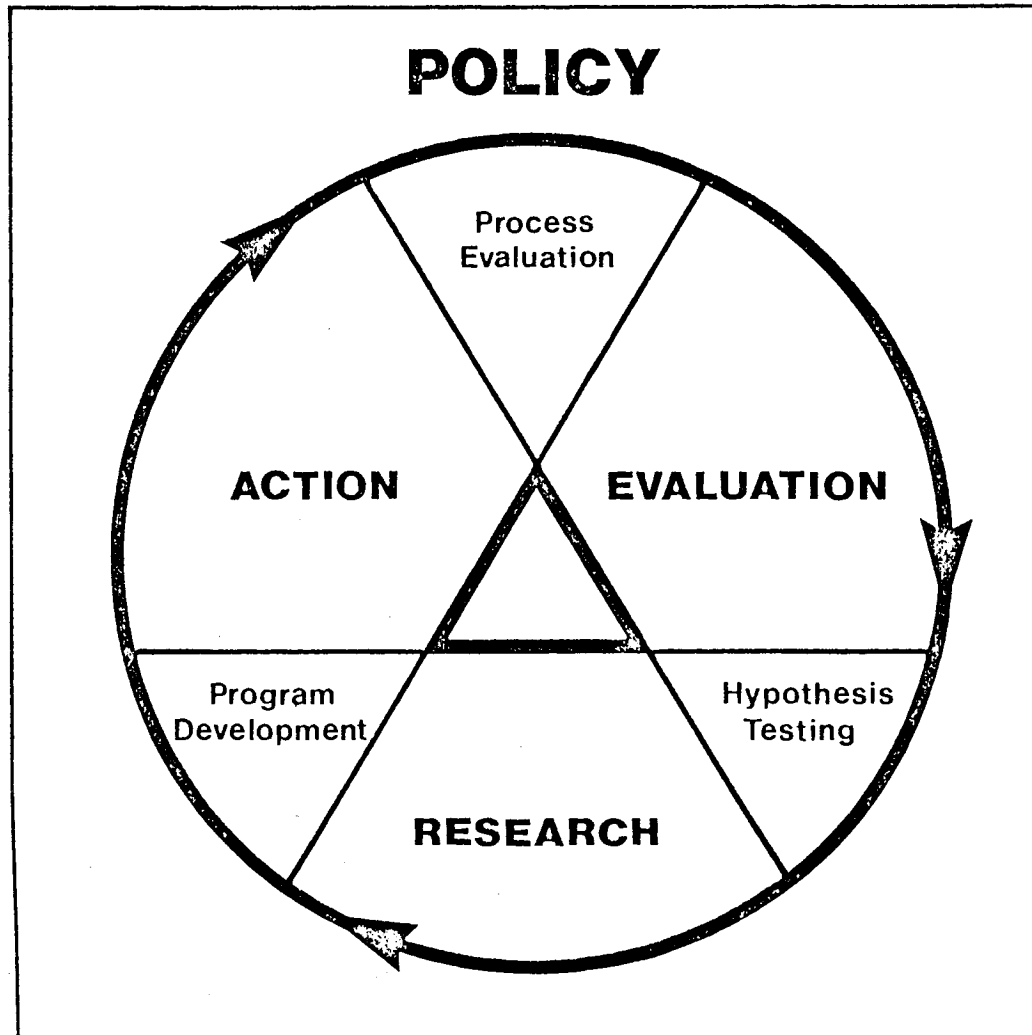


Source: Donelson 1982

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FIGURE 31

REDUCING MOTOR VEHICLE ACCIDENT LOSSES: A PROCESS



Source: Donelson 1984b

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are designed in accordance with that policy. If not, then "evaluation as activity" will continue as a "political football"; countermeasure programs will continue as "shots in the dark"; and researchers will continue to play the "zero-sum game". One is tempted to add, risking further hyperbole, that the "intolerable problem" of alcohol-related deaths and injuries due to road accidents will also continue, unchecked.

PART THREE

FUTURE STRATEGIES AND PRIORITIES

9.0 FUTURE STRATEGIES AND PRIORITIES

There are two simple questions often lost in debates over what to do about the problem of alcohol and road accidents:

1. What do we know?
2. Where do we go from here?

This report has provided extensive data on the magnitude and characteristics of the alcohol-crash problem. In summarizing present knowledge, it also looked into issues--questions still not answered by the hundreds of studies and their statistics. All appearances aside, past efforts have stressed "doing something about the problem", not understanding it. The present base of knowledge on which future initiatives must build seems riddled with informational gaps. The lack of knowledge in many areas, particularly social and behavioural aspects of the problem, will impede definitive action in the near term along many fronts.

To some active in the field, advancing knowledge about the problem has low priority. Those who denigrate research efforts often claim no need for more information. To their minds, the cornerstones of society's response to the problem--new or revised legislation, increased enforcement of alcohol-impaired driving laws, stiffer penalties for persons convicted of alcohol-related driving offences, and awareness campaigns in the media--require little in the way of "more research".

Thus, answers given to a follow-up question--"What should we know?"--express divergent opinions and lead to renewed debates over the adequacy of the present state of knowledge. From cross-disciplinary discussions among experts (e.g., Donelson 1983c) reasons for these disagreements begin to emerge. The perceived need for more information is a function of the countermeasure approach or action program advocated by each. At the same time, very few if any would argue that there is no need for information on the effects--and the cost-effectiveness--of policies and programs, whether or not they require prior research and development.

Given what is known (and not known), the second question "Where do we go from here?" often proves even more contentious than the first. The common goal of reducing alcohol-crash losses does not appear to encourage consensus among those responsible for policies and programs. To a large extent the difficulty rests with the complexity of the problem itself. The nature of the problem admits to no one solution--and, at the same time, to many solutions. Each active agency or organization has its own perspective and approach. Each naturally favours its own over others'. The field has filled with different points of view and a host of alternatives vie for attention. The issue of perspective and strategy often becomes one of "either-or" rather than a search for synthesis and common ground.

Basic differences of opinion also center on philosophical issues, for example, the following:

- o Should society continue to rely heavily on law-based, punitive measures, or should programs dealing with social and behavioural factors that give rise to the problem receive greater emphasis?
- o Should the ultimate goal be complete separation of drinking from driving, or should it be to prevent driving with blood alcohol concentrations (BACs) over a certain limit?
- o Should action programs (and the funds to support them) flow top-down from government, or should community-based grassroots efforts become the fulcrum of social change?

Philosophical debates may seem irrelevant to many concerned only with action. They do serve, however, to expose hidden assumptions and preset biases. They also serve well in clarifying the basis of social policy in terms of general objectives and future directions.

Given the diversity of opinion in the field and the lack of agreement on how best to deal with the alcohol-crash problem, it might appear highly presumptuous to discuss future strategies and priorities in this report. Nonetheless, recent developments in the field suggest the broad outline

of an emerging consensus. From this generally accepted framework of thought have come ideas that foster communication, cooperation, and other hallmarks of successful social movements. In this context it seems very appropriate to address strategies and priorities.

No one individual, group, or agency has yet drafted a blueprint for successful social action to end the alcohol-crash problem. What follows--lessons from past experience and options for future action--is not that blueprint. It relates more to requirements and preconditions for the careful consideration of future strategies. Of course, the setting of priorities for action, evaluation, and research will occur even in the absence of such strategies. If the history of efforts to reduce alcohol-crash losses offers one important lesson, it is that priorities should reflect strategy, not only readily available tactics.

9.1 Lessons From Past Experience

The ebb and flow of social action to reduce alcohol-crash losses has seemed an historical, even predictable pattern. Nonetheless, the current wave of public concern is unprecedented in North America for its intensity, its sustained momentum. The crucial role of citizen activist groups in bringing drinking-driving issues to attention throughout society has taught experts in the field a valuable lesson: knowledge about a problem does not guarantee political action to deal with it. Research reports filled with statistics seem impotent compared to the combined voices of small but committed groups of persons directly affected by the problem. The "problem-solving models" discussed in Section 5.1 (Figures 28 and 29), therefore, do not really reflect the present dynamics of the field. The demand for action to which decision-makers respond comes less from research than from the people. Moreover, people who demand action find their motivation in heart-felt emotion borne of personal experience, not in cold-hearted statistics. One more lesson lies implicit in the movement itself: that public support of--and involvement in--social and political action at the grassroots level is a critical (and hitherto missing) factor in the overall societal response to the alcohol-crash problem.

Another set of lessons comes from observations of recent trends in the field. These relate to the number and type of key actors and stakeholders as well as to the scope and diversity of possible efforts.

First, the notion of an "Alcohol Safety Community" that includes only Research and Countermeasures Communities now appears inadequate to characterize the field as a whole. The integral involvement of citizen activists and private industry (alcohol beverage, insurance, and motor vehicle sectors) has immersed the dichotomy between research and countermeasures in a welter of special interests. The questionable existence of an actual Alcohol Safety Community has become even more uncertain. The lesson is that ownership of the alcohol-crash problem now extends beyond those who have studied it and those who have taken action to deal with it in the past.

Second, the sense of a common mission--to reduce if not eliminate alcohol-crash losses--has become less firm. The focus on drinking and driving per se has blurred to include drinking problems and driving problems as well. To appreciate this trend, we have to acknowledge that deaths, injuries, and disabilities due to road accidents are not yet, in and of themselves, an important social issue. Nor are the many health and social problems associated with alcohol abuse in society an important social issue. At present, THE issue is "drunk driving". For example, groups and organizations primarily concerned with alcoholism and alcohol abuse--finding little or no response to their pleas for support--have now jumped onto the "drinking-driving bandwagon". They carry long lists of alcohol control measures, which they advocate in the name of reducing the alcohol-crash problem (e.g., raising the drinking age, increasing the price of alcoholic beverages, and banning advertising of beer from television). Similarly, agencies generally concerned with road safety also discover drinking and driving as the "only game in town". They advocate safety regulations and other measures and cite their potential value in reducing alcohol-crash losses (e.g., passive and automatic restraint systems, photographs on driver licences, and driving restrictions for adolescents). The lesson here, perhaps, is that alcohol-impaired driving and alcohol-related road accidents as

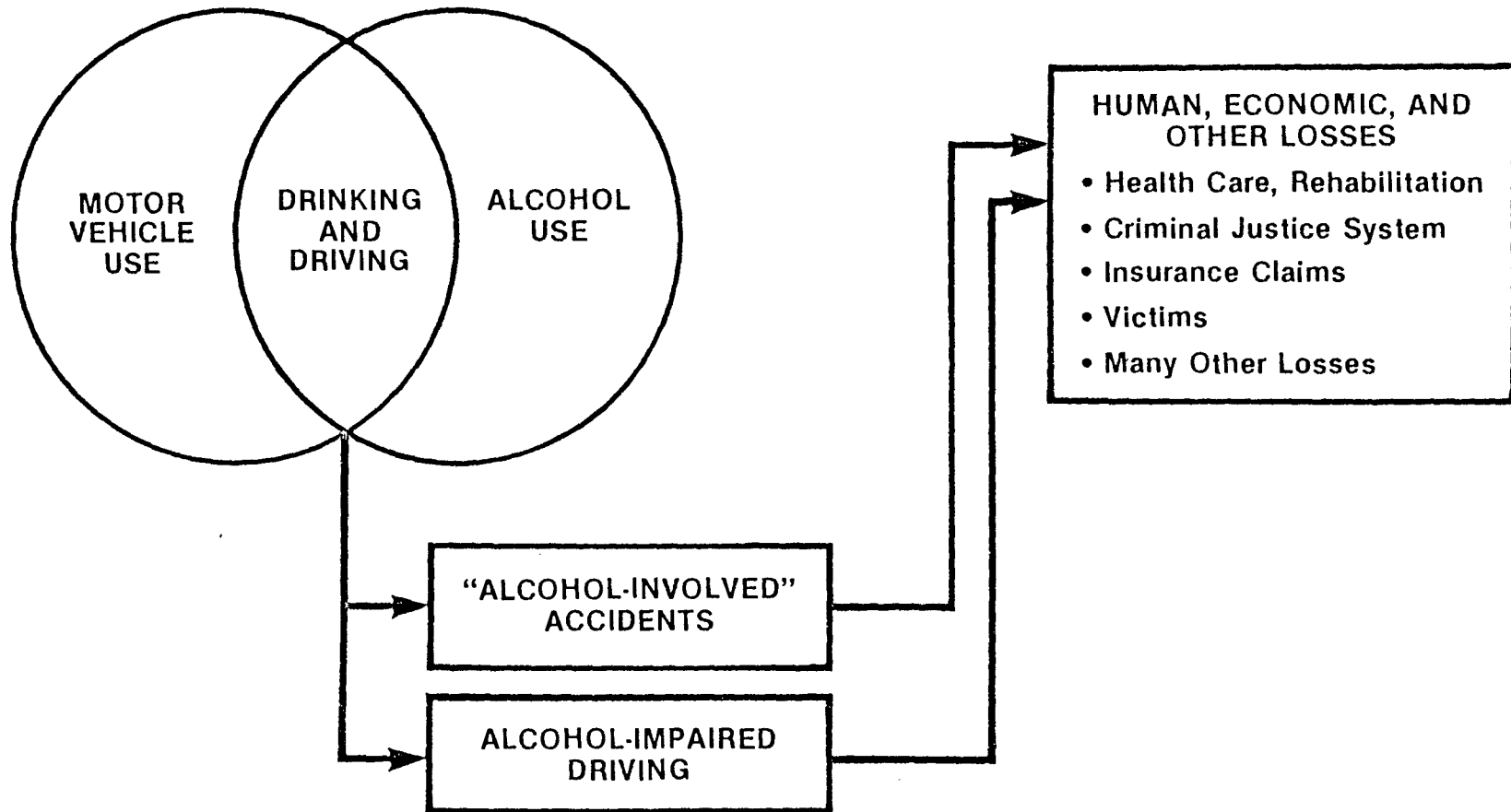
social problems have broader health, safety, and legal implications and that the problem area transcends narrower definitions of "alcohol and traffic safety" common to the past. More extensive and concerted involvement of alcohol and road safety interests, therefore, can be a step towards more comprehensive efforts rather than a dilution of strength.

At the same time, decision-makers will have to scrutinize the appropriateness of measures specific to alcohol control and road safety should their sole justification be "reducing the alcohol-crash problem". Alcohol control policy and risk management in road safety have legal, social, economic, and other implications unrelated to drinking-driving problems. Possible benefits in terms of decreasing alcohol-related road accidents--if the likelihood of such appear probable--may be more than offset by costs in other sectors of society. Trade-offs will come hard, given the frequent, emotion-based assertion that "if only one life is saved, the law (or program) will be worth any cost". Many advocates of specific measures fail to consider that alternative approaches might save more lives and at lower cost to society as a whole. Such decisions are, of course, political in nature. Few will be straightforward. None will have benefits without costs.

The third lesson learned from recent experience concerns formulations and conceptions of "the problem". In the past, the problem was simply defined as the overlap between two common, widespread behaviours (see Figure 32). The combined use of alcoholic beverages and motor vehicles gives rise to drinking-and-driving behaviour. The outcomes of this behaviour--alcohol-impaired driving and alcohol-related road accidents--result in human, economic, and other losses, the ultimate source of concern. This conceptualization of the problem inspired the obvious solution: separate drinking and driving. The past fifty years, reflected in the recurrent message "don't drink and drive", have been spent for the most part in searching for THE solution, the "magic bullet" to end the problem once and for all. There is now growing acceptance that past ways of thinking about the problem have been too simple, even simplistic. Certainly, almost all frontal assaults aimed

FIGURE 32

MIXING ALCOHOL AND MOTOR VEHICLES



at separating drinking from driving have failed to reduce alcohol-crash losses measurably if at all.

Renewed attention to the alcohol-crash problem and reexamination of unresolved issues have led many to realize that there exist numerous ways to define the problem (see Donelson 1983c, pp. 12-14). That the question "What is the problem?" has many answers reveals much. The answers themselves describe positions and points of view--some narrow, some broad--and determine how and where emphasis is placed in dealing with the problem as defined.

Neat, precise definitions of "the problem" have yet to appear. What is clear, however, is that such phrases as "alcohol and road accidents", "drinking and driving", and "drunk driving" conceal the known complexity of the problem and obscure the issues, many of which go beyond drinking and driving per se. Figure 33 illustrates this point. Both drinking and driving include a wide range of person and social patterns of use, some problematic, others not. The manufacture, distribution, and sale of motor vehicles and alcoholic beverages represent billion-dollar enterprises and key strands in the fabric of society. Laws and regulations pertaining to each have a complexity all their own, stemming from social control policies that attempt to reconcile conflicting aims of economy, justice, health, and safety. Beyond the use of motor vehicles and alcohol, beyond individual behaviour, the very structure of society and culture-based social practices contribute to the problems of alcohol-impaired driving and alcohol-related road accidents. Separating drinking from driving, or driving from drinking, admits to no simple solution, even in the abstract.

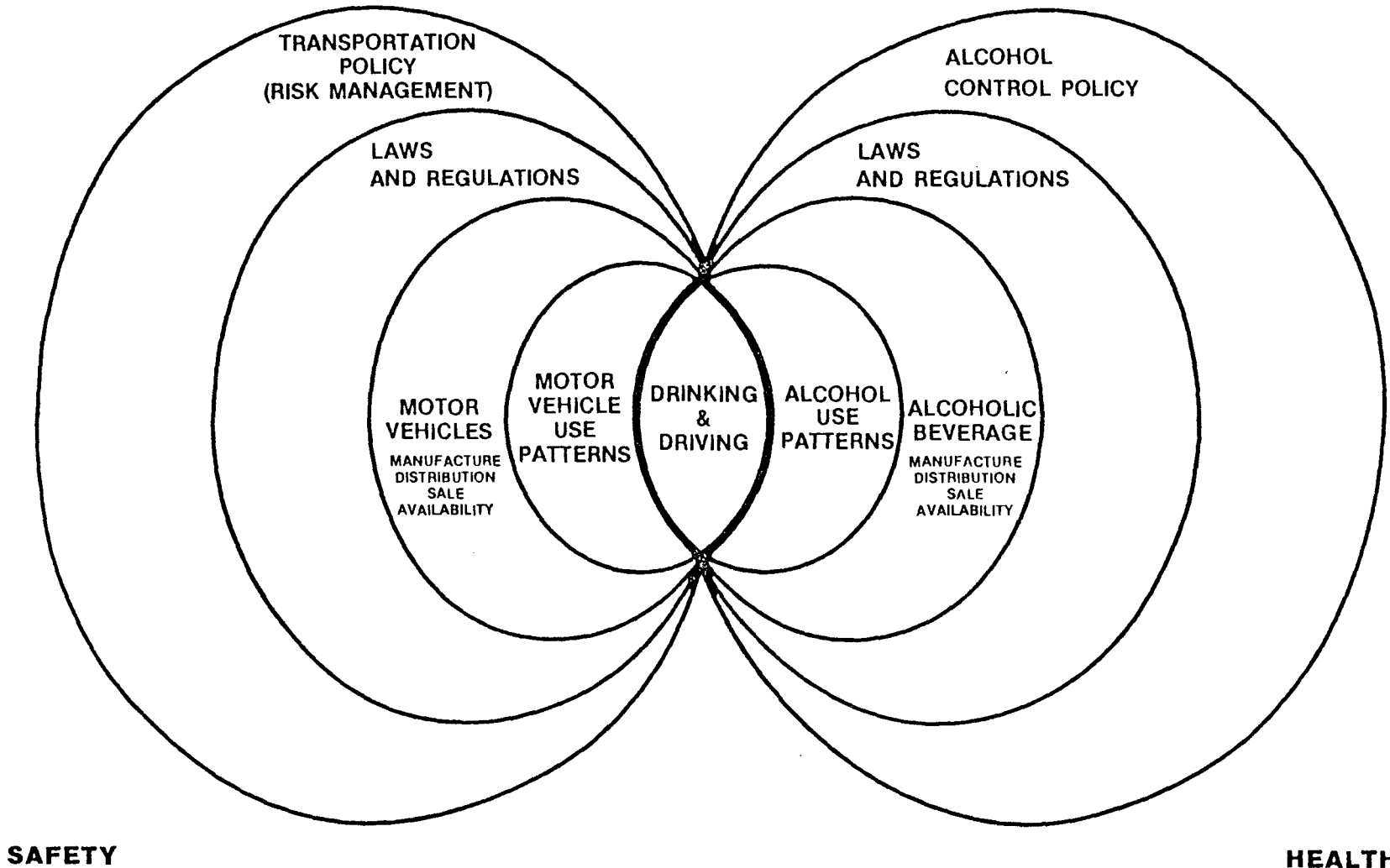
These and other lessons have confronted those concerned about alcohol and road accidents with questions and issues that go far beyond "the problem is big" and "something has to be done about it". Unfortunately, a tidal influx of new faces to the field has occurred, including whole agencies and organizations with no appreciation of the history of the field--much less even a passing familiarity with knowledge gained over decades of effort. Many have reengaged the "reinvent-the-wheel"

FIGURE 33

ALCOHOL AND MOTOR VEHICLES: BEYOND DRINKING AND DRIVING

ECONOMY

JUSTICE



syndrome endemic to long-standing efforts to deal with this social problem. Thus, at a time when key issues have surfaced for resolution, calls for one-shot, single-measure solutions again permeate the airwaves, each solution advocated with little if any recognition of the complex diffuseness of the problem itself. Few advocates appear to consider the broader social implications of their tactics. Many scientists have yet to step down from their ivory towers to assess how conclusions from their limited findings would work in the real world.

One advantage, of course, is the increased number of key actors and stakeholders (see Figure 34). Even five years ago the cadre of people active in the field was small, even diminishing. One disadvantage, arising from a traditional failure to communicate effectively among cross-disciplinary groups, is the difficulty of transferring to the many more active groups that knowledge which now exists. The danger, given the history of our efforts to date, is that critical time, energy, and other resources will be spent relearning lessons from the past rather than building toward the future--putting into place policies, plans, programs, and, of necessity, research and evaluation activities, all of which will ensure a long-term, comprehensive coordinated approach to this problem.

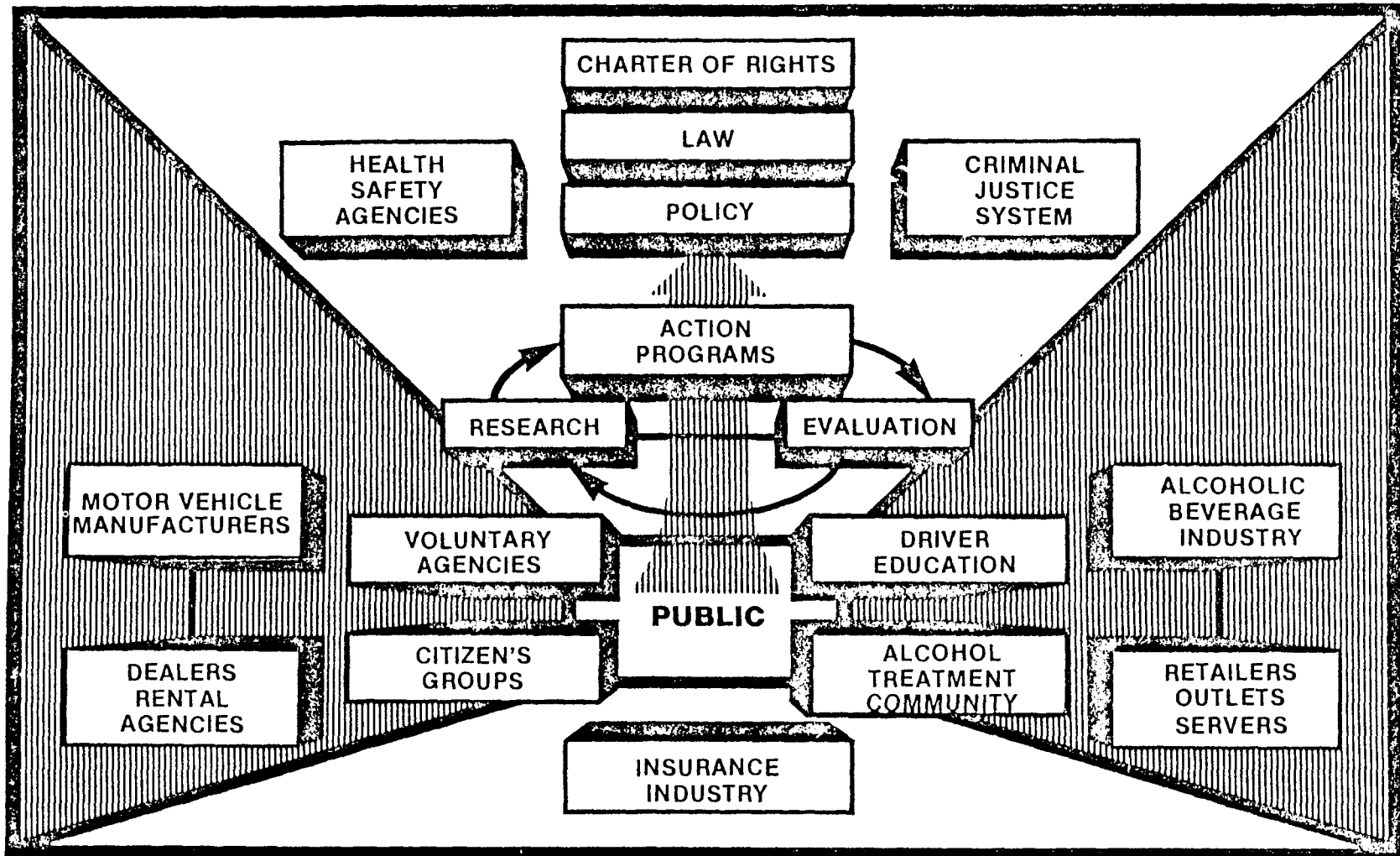
This report began by identifying a general issue that seemed paramount:

- o Are new initiatives possible for reducing road accidents and losses due to alcohol-impaired driving, or must past actions to deal with the problem--based on traditional and largely ineffective approaches--be continued, with efforts perhaps increased ten-fold?

This issue arose because, as shown in preceding sections, there is no shortage of solutions, only a shortage of those that work. In reviewing the great variety of solutions, almost all of which have been tried at different times in different places, one might have a feeling of frustration, if not of hopelessness. Nevertheless, we cannot yet conclude that nothing will work to reduce alcohol-crash losses. We first have to reassess how we as a society have approached the problem in the past.

FIGURE 34

ALCOHOL AND MOTOR VEHICLE ACCIDENTS SOME KEY ACTORS AND STAKEHOLDERS



Briefly stated, we have dealt with drinking-driving problems in a fragmented, haphazard, even superficial manner. Consider the phrase "war against drunk drivers", which reflects the attitude of many concerned about the alcohol-crash problem. If a general threw his troops and armaments into battle the way we have approached this "war", we might say the general was begging for defeat. The military analogy, however unfortunate, does offer valuable guidance: (1) the emphasis on strategy, not just on tactics; (2) the explicit recognition and support of intelligence gathering (research), both before and after engaging the enemy; and (3) the careful marshalling of resources, especially in wars of attrition. The analogy to military affairs could go further than the above--if we agree that there exists an enemy apart from ourselves. Here, perhaps, we encounter a truly contentious issue.

For example, we have in the past painted a picture of the drinking driver as the "killer drunk": the excessively impaired, morally reprehensible criminal who, with reckless and wanton disregard for the lives and safety of others, wrecks havoc, mayhem, and carnage on the highways. This image certainly fits at least some among us; nevertheless, this description, similar to many once again found in the media, seems mostly myth. As Gusfield (1981) observed, such stereotypical images serve well in rallying support for impersonal, authoritarian approaches to deal with the alcohol-crash problem. They also obscure the reality of drinking-driving behaviour. If we study the results of roadside surveys, we find no one identifiable subgroup in the population at risk responsible for causing most alcohol-related road accidents. Most drinking drivers are otherwise responsible citizens in good standing in their communities. The wise words of Walt Kelly's Pogo--"We have met the enemy and he is us."--probably holds true for drinking-driving problems.

Most victims of drunk drivers and some experts in the field might argue differently. They would contend that the alcohol-crash problem is due to the irresponsible, criminal behaviour, or "lifestyles", of the few. They would also "target" this ill-defined, amorphous core of problem drinking drivers for even stronger action. Tougher laws, increased

enforcement, and stiffer penalties are the oft prescribed remedies. Occasionally, in apparent deference to pleas from those concerned with alcoholism, they will also recommend treatment for drinking problems, once offenders have received their due punishment.

The contentious issue mentioned above might best be described as "revenge versus renewal". If new efforts to reduce alcohol-crash losses are indeed a redeclared war against an enemy, then police action, punishment, and other forms of repression seem appropriate. However, if reducing the problem requires broader based social initiatives--efforts that include most if not all of us--then sole reliance on the criminal justice system and other regulatory control mechanisms seems shortsighted and ill-conceived. A disappointing lesson from lengthy experience is that the criminal justice system alone does not seem able to produce substantial, sustained reductions in the core problem--deaths, injuries, and disabilities due to alcohol-impaired driving. This lesson has only recently become acknowledged, not fully accepted. As Mark Keller (1982) has written:

Passing a law is a favorite American way of dealing with public problems. The national Congress, fifty state legislatures, a proliferating host of regulatory bureaucracies, thousands of local legislative bodies, are legislating and regulating ceaselessly. Even on Sunday. Not even a justice of the Supreme Court knows all the laws he must obey. And it is possible that there are more laws about alcohol than on any other object. Whether any of these laws is effective in mitigating alcohol-related problems is matter for speculation. Perhaps abolition of all the laws about alcohol would not make much difference.

Of course the laws against drunken driving empower the police to arrest drunken drivers, and the courts to punish them. Everybody agrees that that's good. But it does not seem that these laws prevent much drunken driving.

How hopefully the director of the Traffic Division of the National Safety Council reported in "Alcohol, Science and Society" on the beginning of the use of chemical tests for intoxication. There was only one portable automatic testing instrument in existence at that time - the recent invention of Professor Leon A. Greenberg in the Yale

Laboratory of Applied Physiology. But already chemical testing was spreading, and police and courts were increasingly accepting the procedure and the results. As soon as enough of these portable instant testing machines were available to catch the breath of suspected drivers, surely the drunken-driving problem would be mostly solved.

The war ended. Chemical test laws and practices were established just about everywhere. Improved testing instruments were devised. And it all made no difference. In the 1920s about 25,000 persons were killed annually in motor vehicle accidents. In the 1970s about 50,000. That does not reflect an increase. The population is bigger, there are more cars, more highways, more drivers and more driving. But drunken-driving accidents and fatalities have not been anywhere near abolished by the grand advance of automatic and on-the-spot chemical testing and all the related legislation, including lowering the blood alcohol concentration at which a legal presumption of fault is made.

What's needed is the wisdom to recognize that lawmaking is not the same as behaviorism. What's needed is to discover how to change people's attitudes toward drinking, driving, and driving after drinking. Everybody knows that. But everybody is busy adding more laws. In this the fashion has not changed. (pp. 8-9)

The situation in Canada, with our well developed (if burdened) criminal justice system and a similar propensity to attack social problems with lawmaking, differs only in scale from that in the U.S. Folk wisdom has it that when you have a hammer, everything look like a nail. In dealing with drinking-driving problems, we have simply failed to look much beyond legal approaches to others that could complement punitive, coercive methods of changing human behaviour.

Finally, one more lesson from past experience concerns responsibility for drinking-driving problems.

Aside from inefficiency, the present fragmented way of dealing with the alcohol-crash problem reflects the diffuseness of responsibility for it. This in turn mirrors the nature of the problem, the causes of which permeate society itself. Few individuals, groups, agencies, or organizations can claim more than a partial mandate to address the whole of

this complex problem. Their areas of responsibility, though related, are as yet functionally separate and uncoordinated. This characteristic of the now burgeoning field suggests that each and every such agency or organization--whether in or outside of government, whether local, provincial, or federal--can take responsibility for the problem in the context of its mission and in ways appropriate to its methods.

At the same time, we have to recognize that differences in philosophy, chosen approach, and specific aims become "territorial imperatives", a tendency exacerbated by the absence of communication channels and by the lack of understanding among key actors and stakeholders. The following issue, therefore, becomes paramount if a "major new initiative" to reduce the magnitude of the problem is to unfold with broad-based support and participation:

How can the many agencies, organizations, and individuals --which represent specialized interests, different disciplines, and separate areas of responsibility--evolve into the type of networks required to develop and implement comprehensive strategic approaches to the problem?

The question of "how" pertains to methods and conditions supportive of, and to requirements for, effective networking. A comprehensive top-down, hierarchical approach to the alcohol-crash problem seems totally unrealistic, given the diversity of interests involved. Even the issue of "strategy versus tactics" will have to be resolved operationally.

The flourishing grassroots movement and the concept of community-based initiatives (Traffic Injury Research Foundation of Canada 1984) extend the issue of "responsibility for the problem" to "the ability to respond to the problem". In this context, the time has come to reconsider views about who is to blame and whose duty it is to deal with the problem.

One view assigns full responsibility to the alcohol-impaired driver or pedestrian but for whose behaviour a traffic accident would not have happened. At one level, this view has great validity. Another view might take into account that we live in a society that encourages the consumption of alcohol and almost demands the use of

motor vehicles. This society also structures itself to bring the two into combination. From this perspective, the impaired driver can appear as a victim (Warren and Donelson 1982, pp. 191-197). Somewhere between the alcohol-impaired driver as "problem" or "criminal" and the alcohol-impaired driver as "victim" may lie a simple truth complicated by our present way of thinking about the problem.

Our glimpse of this truth suggests that all of us are part of the problem and, therefore, we can all take personal and individual responsibility for it. Our taking of responsibility, as well as committing ourselves to participate in reducing alcohol-crash losses, are preconditions for a major, long-term co-ordinated effort. To blame others while absolving ourselves cannot hide what appears as stark reality: We as a society of individuals have created the problem. If we do not take responsibility for resolving it, who will? After all, we have learned one lesson offered by the alcohol-traffic safety experience--the alcohol-crash problem will not disappear on its own (Donelson 1983c, p. 36).

The above perspective on responsibility underpins the trend toward community-based initiatives, efforts by concerned members of communities to deal with alcohol-impaired driving and its consequences locally. This approach has become one of several options for future action discussed below.

9.2 Options for Future Action

The complex social and political task of charting future directions and applying lessons from past experience is not--and cannot be--the sole province of any one individual, group, or government. To undertake this task probably ranks with such efforts as putting people on the moon and returning them safely. Despite the level of effort required, failure to engage the task would indicate a certain tolerance of the alcohol-crash problem, not to mention an attitude of defeatism.

Moreover, the evolution of societal responses to the alcohol-crash problem will undoubtedly take time. A decade or longer may pass before statistics show measurable, sustained reductions in the magnitude of the problem. Our collective preference, of course, is often for quick

action and short-term success. We have to acknowledge that benefits of this course of action have generally proved effervescent: small, short-lived effects bought at great price.

Thus, a careful, systematic approach to defining future strategies and priorities will require, first and foremost, imaginative thought and great patience.

It is said that a ten-thousand kilometre journey begins with a single step. In the spirit of that ancient (though up-dated) aphorism, an international, cross-disciplinary group of experts gathered in late 1981 to consider future strategies and priorities (see Donelson 1983c). They examined major issues related to alcohol and road accidents and discussed priorities for future action. In deliberating the alcohol-crash problem, the panel of experts reaffirmed what has been stated before:

- o that the problem persists at an intolerable level, despite long-term outlays of public funds and other resources to deal with it; and
- o that a new initiative must be developed to effect a substantial reduction in the magnitude of the problem.

In simpler words, of course, they said that "the problem is big" and "something must be done about it". Had they stopped there, the meeting would have--and should have--gone unnoticed. They went on, however, to outline a comprehensive, strategic approach to the problem. The group also identified conditions and requirements that must be satisfied for this approach to become operational. The workshop as a whole was considered by many valuable and influential (e.g., Ross 1982). Its outcome represented a first step toward more concrete formulations of policies, plans, and programs.

9.2.1 The first step: A strategic approach and its rationale. The panel of experts mentioned above, along with many others active in the field, now recognize that meaningful in-roads will be made only as a result of a major, coordinated, long-term effort. This kind of effort

constitutes the required "new initiative". It includes traditional approaches to the alcohol-crash problem--legal, health, educational, etc.--and also includes other, innovative approaches as well. This recognition builds on the conclusion that there exists no single "best" strategy based on specific types of countermeasures. Rather, a strategic approach combining many tactics, unified by a comprehensive, operational plan, best satisfies the many needs identified as critical in this area.

Of primary importance, then, is a detailed, implementable strategic plan. Strong governmental commitment both to a long-range plan and to accepting leadership in supporting its implementation are essential prerequisites for a successful outcome. In assuming a strong leadership role, governments must ensure that a multifaceted plan to reduce the alcohol-crash problem can unfold systematically. In the absence of coordination, simply increasing the amount of funds for the separate activities of individual agencies offers little promise of effectiveness in the long term. In contrast, supported by an explicit, long-term commitment to deal effectively with the problem, a combined and integrated program that includes action, evaluation, and research components, carried out in an iterative fashion, promises much in terms of long-range effectiveness.

In general, sustained decreases in the number of traffic deaths, injuries, and other losses due to alcohol-impaired driving remain unachieved goals of health and safety interests. Many factors have contributed to the apparent lack of progress: socially ingrained patterns of alcohol and motor vehicle use; inadequate resources allocated at federal, provincial, and local levels of government; programs conducted without assessing their effectiveness; and the fragmented nature of past efforts as a whole. Research has shown that the alcohol-crash problem pervades society in a diffuse, complex way. An effective social response must address the problem in a corresponding way. The current, almost haphazard response will not produce hoped-for gains. To establish a more effective, coordinated response--one that

supports the major, long-term effort required--demands a strategic approach integrating the many disparate elements.

This approach represents a process, not a panacea. As a process, it can incorporate short- and long-range plans and programs with distinct though interrelated objectives. The potential value of this approach depends wholly on people willing and committed to bring about its development and implementation.

9.2.2 Some "next steps". How to develop and implement a strategic approach--whether at federal, provincial, or local levels--must now be addressed. Once the need to do so becomes generally accepted, then a basic requirement is to continue the process of strategic planning, to operationalize the concept.

As applied in military and industrial organizations, "strategic planning" is a formal, stepwise procedure. Its function is (1) to define precisely the mission or raison d'etre of the enterprise; (2) to specify clearly goals and objectives; and (3) to develop strategies to accomplish them. The strategies will take into account external and internal factors, both present and future, that may affect the overall mission and its aims. Thus, strategic planning is a top-level function that develops plans and programs through which aims are accomplished.

An initial step in the strategic planning process might involve forming a "Strategic Planning Committee". At a national level, this body might include acknowledged experts from across Canada, representing the many disciplines required for this task. Its primary purpose would be to develop in greater detail a comprehensive strategic plan that could guide sustained initiatives at federal, provincial, or local levels. The study group would examine--in depth--major, unresolved issues and periodically publish reports on the state of the art. Far from exclusive, the Strategic Planning Committee would interface with, and receive input from, concerned industries, governments, voluntary agencies, and the public. Such a group could serve a broad array of interests, both

public and private, as a resource available to support the development of short- and long-term initiatives.

In recommending that the process of strategic planning continue--whether or not by a specially mandated body--we have to acknowledge not only its importance but also the degree of commitment needed to bring it to fruition. Numerous barriers to accomplishing the task exist. Nonetheless, strategic planning done thoroughly offers an effective means to confront and resolve basic issues that could thwart--indefinitely--the best intentions of all who share the goal of reducing alcohol-crash losses.

The cross-disciplinary, interagency effort involved in strategic planning points to another "step" toward an effective societal response to the problem.

Current actions tend to fractionate along lines of discipline, function, and political subdivisions. The lack of communication among the numerous, diverse interest groups seems chronic. Given the perceived need for a combined and integrated response to the problem, increasing communication among key actors and stakeholders in the field becomes essential. Increased communication may lessen the discordant influence of "territorial imperatives" prevalent among researchers, practitioners, policymakers, and citizen activist groups. By enhancing mutual understanding, increased communication would facilitate the removal of barriers between governmental and nongovernmental agencies; between those who initiate and carry out programs and those who would evaluate them; between policymakers and the perennial opposition party, researchers; and between the public and private sectors. A greater exchange of information--and, more importantly, ideas--would serve to reduce redundancy in the field, which manifests as the "reinvent-the-(square)-wheel" syndrome.

Concrete steps toward forming and opening communication channels might include:

- o publishing directories listing active agencies and groups, as well resources available to support future programs;
- o holding periodic conferences and workshops to bring together representatives of interested parties and to maintain an on-going dialogue;
- o distributing newsletters that report recent events, on-going developments, and innovative programs relevant to alcohol, road accidents, and drinking-driving; and
- o establishing a national (or provincial) clearing-house to identify, collect, and provide informational resources to those groups and agencies needing them.

"Increased communication", however, does not mean more "show-and-tell". The resolution of substantive issues will require careful, thoughtful discussion. A spirit of cooperation and a willingness to participate in creating the new initiative will greatly support not only the aim of effective communication but also the (perhaps idealistic) goal of reducing alcohol-crash losses.

Like knowledge, communication alone does not ensure effective action. Activity in the field resembles more a competition than a cooperative venture. For example, researchers vie for limited funds from agencies offering grants and contracts. Governmental agencies jealously guard their partial mandates in the area. Many agencies (both inside and outside government) prefer to function autonomously, as if to say "we'd rather do it all ourselves". To the extent this characterization of the field is accurate, efforts to facilitate interagency cooperation and collaboration should receive high priority.

Growing appreciation of the nature of the alcohol-crash problem has led many to believe that effective action will require a complex network of multiple agencies, organizations, and individuals functioning at all levels of society. This is not to say that we need a megalithic bureaucracy incorporating all functions that address all aspects of the problem. Conceiving of such, much less establishing one, seems

impossible. We would have to restructure our entire social system in the name of dealing with the alcohol-crash problem! As an alternative, however, we might envision links and arrangements that enable networking as a general approach to the problem. Seeking out and establishing cooperative efforts will assist in dedicating each part in service to the whole. Interagency, collaborative projects--federal-provincial, interprovincial, intraprovincial, provincial-local--should become the hallmark of activity in the field, not the exception to the prevailing rule. Governments as well as communities could form interdepartmental or interagency commissions or task forces to lay the groundwork for cooperative programs. Here, too, a national (or provincial) clearing-house dedicated to the area of drinking and driving would assist in networking by identifying and linking potential collaborators. These recommendations may appear overly ambitious, if not wishful thinking. Nevertheless, in the absence of such functional structures or organizations that have continuity in the field, not to mention some assurance of permanence, it is difficult to imagine how a "long-range, comprehensive, coordinated, strategic approach" can evolve, much less be sustained.

A critical step in realizing a strategic approach--whether initiated by government or by concerned communities--is resolving the issue of funding. Broad-based, long-term efforts will not take root without resources allocated to sustain them. A precondition for obtaining needed support is the commitment to devote monetary and other resources commensurate with the magnitude of the problem. Comprehensive programs that integrate evaluation and research cannot be developed and implemented with "conscience" money. Governments might consider allocating a percentage of present tax revenues from the sale of gasoline and alcoholic beverages--two products that give rise to the alcohol-crash problem. An alternative is generating new revenue from a special added tax on these products, targeted directly to drinking-driving programs, evaluation, and research. Concerned industries (motor vehicle, insurance, and alcohol beverage) might consider establishing a pooled fund to support local or independent initiatives aimed at reducing alcohol-crash losses. However resources become available, funds to support strategic

approaches to deal effectively with the problem are a critical factor. Strategic planning without substantial monetary backing becomes a weak, academic exercise. The unwillingness to support comprehensive, long-term initiatives, however, would reflect more on society than on the importance of the problem.

9.2.3 Beyond research as a "four-letter word". As recently illustrated by the on-going acid-rain controversy, research is often perceived (sometimes, rightly so) as something to do when one wants nothing done about a problem. In relation to the alcohol-crash problem, this popular perception--that doing research means "doing nothing" or "studying the problem to death"--has two pernicious effects: (1) The traditional emphasis on action programs persists, relegating efforts to advance knowledge and to increase understanding to piecemeal, cursory projects. (2) Two functions critical to dealing with drinking-driving problems effectively over time--namely, research and evaluation--often turn up missing in so-called "comprehensive programs".

In spite of general misgivings about research per se, Science is so pervasive and influential in our culture that most people accept the following principle:

Understanding a problem--especially one that persists in spite of best efforts to date--is essential for its successful control.

Few would challenge the application of this principle in Medicine. Research into the causes and prevention of cancer and heart disease--health problems of comparable magnitude--receives tremendous support from both governments and private citizens. The function and role of research in dealing with the alcohol-crash problem, however, is often questioned.

The lowly status of research in relation to drinking-driving problems partly results from the belief that present knowledge is adequate and, perhaps, from the way research is thought to contribute to problem-solving in this area. The assertion that present knowledge is adequate

is sharply contradicted by the long lists of unanswered questions drafted by an international group of experts (Donelson 1983c, pp. 39-42). The conception of research deserves discussion.

In the area of alcohol and road accidents, research is usually conceived as an activity to provide information about the extent and characteristics of the problem. This function has been termed problem definition or risk identification. In most models, research relates to action programs in a linear way: problem definition leads to the identification of high-risk target groups, which in turn leads to development of countermeasures. On rare occasion, some planners might include evaluation as a step after countermeasures, with stress on the empirical (or research) aspect of evaluation. This common conceptualization ignores the dynamic nature of the overall social response to the alcohol-crash problem and perpetuates the idea that research serves only to develop countermeasures (Donelson 1984b,c). Given the dozens of available countermeasures, the consensus that "something must be done now" (with very limited resources for immediate action) pushes research to lower priority and into the ranks of expendable projects. As a consequence, links between research and action programs are frequently disrupted or missing, producing chronic informational gaps.

By its very nature, the purpose of research is to close informational gaps. To appreciate this more fully requires broadening the concept of research. Research as an integral, functional component of comprehensive programs involves the creation of information, the processing of information, and the distribution (or communication) of information. This conceptualization is consistent with the shift evident in Western countries from industrial societies to informational societies (Naisbitt 1984). Viewed in this way, the role and function of research becomes more concrete.

The model introduced in Section 8.4 to discuss evaluation (Figures 30 and 31) provides a useful starting point, as does a definition of the fourth component, policy:

A definite course or method of action, selected from among alternatives and in light of given conditions, to guide and determine present and future directions.

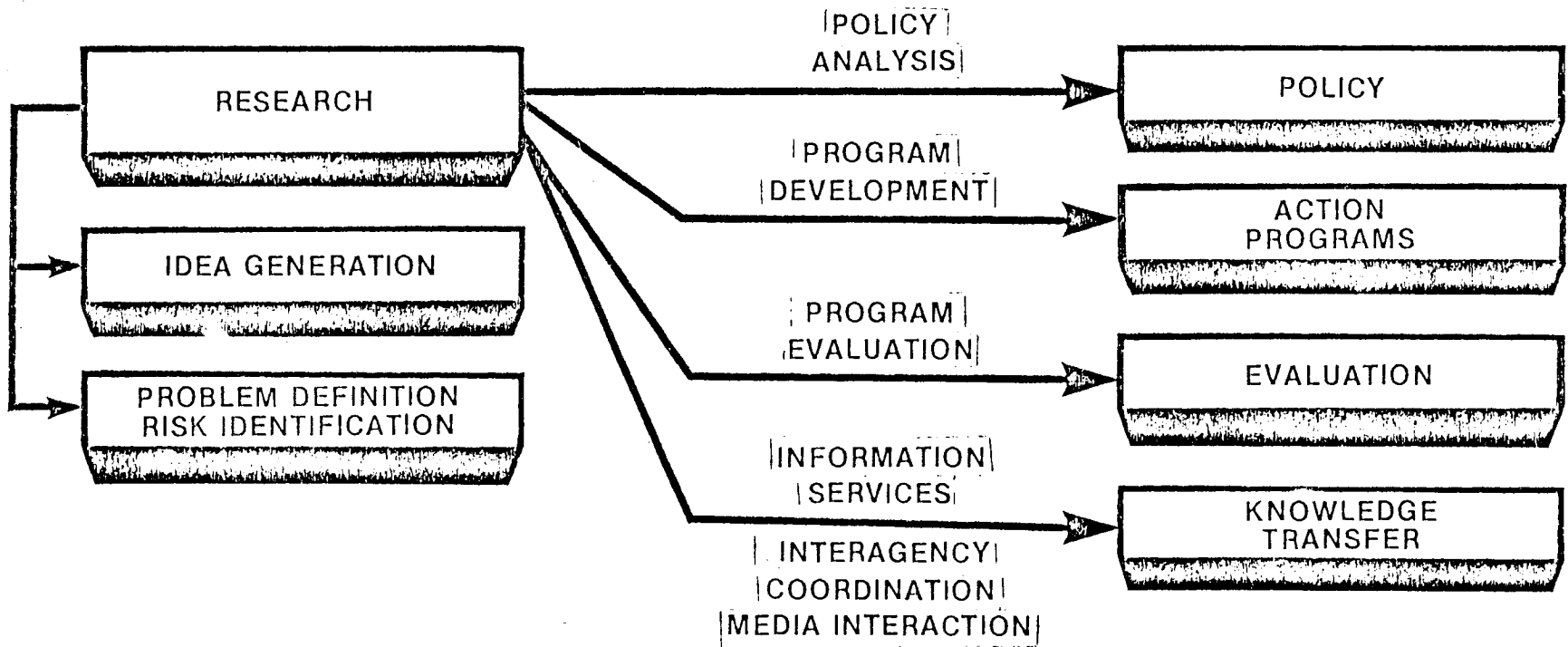
The need to identify "alternatives" and to assess "given conditions" strongly implies the need for information and, therefore, for research. If we accept the need for research-based information, then using the model we can define more specifically the role and function of research in the overall process of reducing the alcohol-crash problem.

Figure 35 illustrates the relationship between research and other functional components of the model. Activities related to research per se, of course, include idea generation, problem definition, and risk identification. In relation to policy, research is better known as policy analysis. Interfaced with action components, research becomes program development and testing. The results of evaluation, when considered scientifically, constitute hypothesis testing. Other functions of research include communication of knowledge gained to the public, governmental agencies, and other interest groups through publications and the media. Research--if conceived and supported as creating, processing, and distributing information--can begin to realize its true potential for stimulating and sustaining demands for effective action. Ultimately, and just as critical, research also creates a sound basis for action. Greater acceptance of the need for research and greater appreciation of its value in the overall effort are crucial steps toward reducing the magnitude of drinking-driving problems. In the absence of greater understanding, effective control seems unlikely, to say the least.

9.2.4 Community-based initiatives. With the advent of citizen activist groups and a strong grassroots movement dedicated to reducing drinking-driving problems, a new, emerging perspective on the effort as a whole has gained prominence (Donelson 1983a,b). With it has come a recognition of the need to deal with the problem at the level of individual, family, group, organization, and community. The perspective itself underscores the need for taking responsibility for the problem of

FIGURE 35

THE PURPOSE AND ROLE OF RESEARCH



Source: Donelson 1984b

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an individual and personal basis and for taking action through community-based initiatives (Traffic Injury Research Foundation 1984).

The "community-based initiative" shifts the emphasis from primary reliance on "top-down" measures designed to do something to and for people to greater stress on people as agents for change within the community itself. This approach also moves away from an "us-versus-them" orientation (as in Mothers Against Drunk Drivers [MADD]) to one that reflects reality: the widespread practice of driving after drinking and its general acceptance as essentially non-criminal, even normative behaviour. In other words, the drinking-driving problem does not arise because of a "few, socially reprehensible drunks", but also because many people "like ourselves" engage in this practice unaware or unaccepting of being part of the problem. This new perspective, therefore, provides a basis for "bottom-up" action programs and explains why the majority of people who have drivers' licences and who also consume alcoholic beverages have an important role to play in the overall societal response to the problem.

Efforts at the community level to reduce drinking-driving problems do not represent a "new" approach or countermeasure. A variety of programs now take place within communities across Canada. These range from local law enforcement to treatment and rehabilitation of problem drinking, from school-based educational seminars to awareness campaigns sponsored by community groups. In the past year alone, the increase in public awareness and concern has spurred interest among many more organizations at the local level.

Along with increased concern and activity has come a definite change in thinking about the problem. Many more people now accept the consistent finding of research: that legal and other punitive measures alone cannot produce sustained decreases in the magnitude of the problem. This and other findings point to a key factor that contributes to the seeming intransigence of the problem: the present social climate and the acceptability of driving after drinking. Strategic approaches aimed

at shifting present social norms and influencing individual choice-behaviour appear to hold great promise for long-term, substantial reductions of the alcohol-crash problem. This view--the need for greater reliance on strategies, plans, and programs to create norms of behaviour consistent with health and safety--is not universally accepted. The need for such approaches to complement law-based countermeasures has at least received general assent (Donelson 1983c)..

As discussed at length in this report, the problem of alcohol and road accidents and its antecedent--alcohol-impaired driving--are complex, diffuse, multi-faceted, and poorly defined. Sophisticated designs employed in epidemiologic studies to advance knowledge about the etiology of similarly complex problems (e.g., heart disease, cancer) have yet to receive support. In the absence of complete understanding of the problem, actions to deal with it have for the most part narrowly focused on isolated symptoms, not on "root causes". Present knowledge, however, does support the concept of, as well as the further development of, social-behavioural approaches at the community level.

In this context, "community-based initiatives" do not mean "top-down" (or hierarchical) programs in microcosm. Nor does "taking action locally" mean only lobbying government to pass certain laws or advocating restrictive measures. Local action, of course, can include these tactics. Rather, the phrase community-based initiatives connotes "comprehensive, coordinated, strategic approaches that combine and integrate action programs, evaluation, and research at the community level....Most importantly, these approaches involve the many concerned agencies within a community in an active, 'grassroots' way, assisted as necessary and appropriate by Provincial and Federal agencies. Briefly put, people within a community would take primary responsibility for handling their drinking-driving problem according to their special requirements and consistent with their level of commitment" (Traffic Injury Research Foundation of Canada 1983c, p.7). At the level of the individual, this approach translates to the question "What can I, as a concerned member of my community, do to participate in, and contribute to, the effort to end the alcohol-crash problem?" Essential to the "bottom-up" approach is greater communication and cooperation

among individuals, groups, and organizations in the community. Just as a governmental agency with a partial mandate to deal with the alcohol-crash problem cannot "do everything" or satisfy all needs, neither can a single community group address the problem locally in a comprehensive, effective way (see Traffic Injury Research Foundation 1984).

According to Naisbitt (1984), trends in social action favour networking over hierarchical approaches and decentralization over centralization. He also used the analogy that "it's easier to ride a horse in the direction it's headed". If his analyses and conclusion hold for alcohol and road accidents, then we can expect that the grassroots, community-based movement to reduce the alcohol-crash problem will gain (and sustain) momentum throughout the decade. Moreover, we might also consider modifying traditional policies and programs that pertain to this area of social and legal concern. The concept of community-based initiatives as defined here seems consistent with recent developments and future directions in the field.

9.3 Summary

This review of research and countermeasures related to the alcohol-crash problem has addressed two basic questions:

1. What do we know?
2. Where do we go from here?

Both questions tend to lead more to debate than to consensus. The need for more information or for increased understanding often depends on the countermeasure or action program favoured by those concerned. Each individual, group, or agency seems to have a particular point of view and a separate agenda for consideration. The general issue of future strategies and priorities thus becomes one of "either-or" rather than a search for common ground.

Recent developments in the field--loosely termed alcohol and road accidents--indicate that discussion of future strategies and

priorities is not only appropriate but also necessary. No blueprint for effective social action to end the alcohol-crash problem yet exists. Nonetheless, requirements, preconditions, and courses of action to reduce drinking-driving problems have become clearer.

Lessons from past experience guide the choice of options for future directions.

- o The demand for action to which decision-makers respond comes less from research than from the people. Public support of--and involvement in--social and political action at the grassroots level is a critical (and hitherto missing) factor in the overall societal response to the alcohol-crash problem.
- o Ownership of the alcohol-crash problem (in the social and political sense) now extends far beyond those who study the problem (Research Community) and those who deal with it (Countermeasures Community). Special interests (e.g., industry, citizen activist groups) have become intimately involved.
- o Alcohol-impaired driving and alcohol-related road accidents as social problems have broad health, safety, and legal implications. The problem transcends narrower definitions of "alcohol and traffic safety" common to the past. A broader perspective has become essential.
- o Given the nature and complexity of the problem, specific measures advocated in the name of reducing alcohol-crash losses require careful assessment for their broader social impact and costs. More complete definitions of "the problem" are needed. Beyond the use of motor vehicles and alcohol, the very structure of society and culture-based social practices contribute to the magnitude and persistence of the problem. Separating drinking from driving, or driving from drinking, admits to no simple solution, even in the abstract. Strategic (not just tactical) considerations become paramount.
- o Increased concern about "drinking-driving" problems has attracted many groups, organizations, and agencies into the field. To avoid "reinventing the wheel" and the traditional fragmentation of effort, two lessons from past experience have to receive greater acceptance: (1) law-based, punitive measures alone cannot produce large, sustained

reductions in the magnitude of the problem; and (2) any and all "solutions" to the problem have a role to play in the overall societal effort to deal with drinking-driving problems.

- o The central issue becomes: How can the many agencies, organizations, and individuals--which represent specialized interests, different disciplines, and separate areas of responsibility--evolve into the type of networks required to develop and implement comprehensive strategic approaches to the problem?
- o A fundamental, philosophic issue underlies the question of future strategies and priorities: responsibility for the alcohol-crash problem. One view assigns full blame to the "drunk driver". Another points to society, political structures, and culture-based social practices. Synthesis and integration of these polar views are much needed.

These lessons from past experience--not all of which have received universal acceptance--provide a starting point from which to consider options for future action.

As recommended by experts in the field, fundamental to future action are major, coordinated, long-term efforts. A strategic approach combining many tactics--unified by a comprehensive, operational plan--best satisfies the many needs critical to this area. Of primary importance is a detailed and implementable strategic plan, one that combines and integrates action, evaluation, and research components. Commitment, leadership, and support of governments (Federal, Provincial, and local) are essential prerequisites to the development of strategic approaches to the problem. Such approaches, however, represent a process, not a panacea.

Development as well as implementation of strategic approaches become "next steps" toward an effective societal response to drinking-driving problems.

Further efforts--beyond the idea of a strategic approach and its general outline and philosophy--involve the following:

- o continue the process of strategic planning, at national, provincial, regional, and local levels;
- o increase communication among key actors and stakeholders in the field;
- o facilitate and encourage interagency cooperation and collaboration, with emphasis on networking; and
- o confront and resolve the issue of funding, to ensure that resources commensurate with the magnitude of the problem will adequately support effective action in the future.

Failure to support comprehensive, long-term initiatives will (with future hindsight) reflect more on society than on the importance of the problem.

Unfortunately, a component regarded by many as critical to the overall societal response to the alcohol-crash problem--namely, research--is still perceived as "doing nothing" or "studying the problem to death". In contrast to areas in Medicine, the function and role of research in dealing with drinking-driving problems is often questioned and nearly always relegated to very low priority. This perception of research and its consequences stems partly from the belief that present knowledge is adequate for immediate action. To a limited extent, this belief seems reasonable. However, the almost imperceptible growth in knowledge; the remarkable persistence (and consistency) of the problem; and the many unanswered questions raised by experts in the field, raise serious doubt about the adequacy of present knowledge.

Concepts and beliefs about the function and role of research also contribute to the low priority of understanding the problem with which we hope to deal effectively. Research does not simply measure the magnitude of the problem and describe drinking drivers. Research as an integral, functional component of comprehensive programs dealing with the problem involves creating, processing, and communicating information. Information about the nature and antecedents of drinking-driving problems is critical to the evolution of policy, plans, and programs. Policy analysis and program development are only two activities that intimately involve "research". Greater acceptance of the need for

research and greater appreciation of its value are crucial steps toward reducing alcohol-crash losses. In the absence of greater understanding of the problem, effective control seems unlikely.

A new, emerging perspective has accompanied the grassroots movement to reduce alcohol-crash losses. This perspective does not deny the role of law-based, punitive measures; it does, however, emphasize the need for people taking responsibility for the problem on an individual and personal basis. Taking action, therefore, not only involves lobbying government but also participating actively in community-based initiatives.

The concept of "community-based initiatives" identifies concerned members of communities as principal agents for change of social norms and practices related to drinking, driving, and drinking-driving. This general approach, however, avoids the "us-versus-them" orientation that characterizes the thrust of most citizen activist groups. Comprehensive efforts in, by, and for the community, therefore, would also avoid sole reliance on punitive measures. Rather, what is called for is a broad-based, multifaceted program to change the social climate and to decrease the acceptance (and necessity) of driving after drinking too much. Essential to this approach is greater understanding, cooperation, and communication among individuals, groups, and organizations in the community. For a community as a whole to undertake a strategic approach to shift (local) social norms and to influence individual choice-behaviour will require a great firmness of commitment--and a strong conviction that "behaviourmaking" is not the same as "lawmaking".

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APPENDIX ONE

APPENDIX ONE
ESTIMATED COSTS OF ROAD SAFETY ACTIVITIES IN CANADA*

1974

(MILLIONS OF DOLLARS)

COUNTERMEASURE	COST
A. VEHICLE SAFETY PROGRAMS	
- Vehicle Standards	285 ¹
- Vehicle Inspection	25 ¹
B. ROAD SYSTEMS PROGRAMS ²	
- Hazards Identification and Correction	6
- Upgrading Road Systems	34
C. ROAD USER SYSTEMS PROGRAMS	
- Driver Examinations and Licensing	25
- Road User Education and Retraining	27
- Publicity/Propaganda	2
- Enforcement	85
D. EMERGENCY MEDICAL SERVICES	N.A.
E. ACCIDENT INVESTIGATION AND RESEARCH	2
TOTAL	491

Notes on Major Exclusions:

1. Excluding costs of repairs, user inconvenience, etc., induced by inspections.
 2. Excluding safety components of costs of new construction plus general or winter maintenance.
- * Report of the Select Committee on Motor Vehicle and Highway Safety, Province of New Brunswick, 1978.

APPENDIX TWO

21. Provide for vehicle impounding for driving while license is revoked or for second DWI conviction within three years.
22. Provide for cancellation of collision insurance if insured driver has BAC above 0.10%
23. Provide for special surveillance of revoked drivers.
24. Develop special pedestrian safety programs in areas of high accident risk or drinking, i.e., (1) better lighting, (2) reroute traffic, (3) reduce speed limits, (4) special caution signs.
25. Provide special patrols to assist intoxicated pedestrians.
26. Arrange for detoxification and treatment assistance for pedestrians.
27. Provide for suspension or revocation of license plates of vehicles owned by convicted drinking drivers.
28. Provide for special tags or registration certificates for vehicles owned by convicted drinking drivers.
29. Prohibit the transfer of vehicles with special registration certificates.
30. Develop mass media public education campaign on alcohol safety.
31. Develop speakers bureau program on alcohol safety.
32. Augment alcohol safety sections of high school driver education programs.
33. Add sections on alcohol to primary safety courses and to appropriate secondary courses (Family life courses).
34. Develop school driver improvement programs for special offenders.
35. Implement a driver assistance program in cooperation with social and health agencies.
36. Provide colored driver licenses for underage persons who might try to falsify entries on a license to purchase alcoholic beverages.
37. Revoke driver's license for multiple convictions of drunkenness, even if unrelated to driving.
38. Establish more severe penalties for drinking and driving.
39. Provide insurance discounts for nondrinkers.
40. Advise taverns and public drinking places of identity of convicted DWI offenders and forbid sale of liquor to them (practical only in small towns).

41. Make tamper-proof breath-meter control of car starting a mandatory device for all vehicles.
42. Control maximum speed according to BAC as indicated by breath-meter.
43. Place notices on liquor and beer bottles telling maximum legal blood alcohol.
44. Use twisting obstacle driving course on the road. Those who knock over cones or lights are tested for alcohol.
45. Take the convicted DWI offender out some distance on a road without buses and force him to walk home (used in Turkey).
46. Revoke licenses of teenagers who drive after drinking any amount.
47. Provide for prosecution of an individual who can prevent an intoxicated person from driving but doesn't.
48. Provide for driver self-testing by commercially available screening breath tests.
49. Revoke license for lifetime after three convictions for DWI.
50. Establish fifty milligrams percent alcohol as legal limit for those under twenty-one.
51. Use state commissions to contact DWI offenders who may be alcoholics for purposes of attempted rehabilitation.
52. Establish national prohibition effectively enforced. (Do special studies to determine why earlier law failed.)
53. Establish crisis intervention centers similar to suicide prevention centers.
54. Promote the adoption of "per se" laws and strong implied consent laws.
55. Establish selective licensing limitation on time or place of permitted driving.
56. Distribute portable breath tester devices to bars.
57. Establish blockades at the roadside.
58. Request high school principals to announce publicly the names of students killed or injured in alcohol-related accidents.
59. Establish measures to increase probability that prosecution for DWI will take place for actual DWI.

60. Establish measures to increase awareness of an increased probability that conviction will follow guilt.
61. Arrange for free mass transit on high drinking holidays.
62. Pass a law stating that to purchase liquor, one's BAC must be less than 0.10%.
63. Show color sound films of DWI suspects to lawyers and court.
64. Make penalties less severe, but more likely e.g., all DWI's are fined two week's pay and required to work for local government for two weeks.
65. Provide "state-dependent" training, i.e., teach persons while they are intoxicated, to drive safely.
66. Educate businesses (for example, promotion of liquorless parties or provision to transport people home without driving, in case drinking does take place).
67. Offer free coffee (mostly to delay driving long enough to reduce alcohol level somewhat).
68. Pay for taxis to take people home.
69. Sponsor the availability of individual non-drinkers at parties.
70. Create a youth driving corps first for holiday driving such as at Christmas and New Years, and then use such a youth driving corps for every weekend (night?) in the year.
71. Provide for imprinting by manufacturers of liquor bottles warning of the dangers above certain levels.
72. Have cab companies with two-man teams of drivers available; a cabbie to drive a drinker home and his companion to drive the drinker's car home.
73. Educate as to methods of diminishing alcohol effects.
74. Search for counter-chemicals to antagonize alcohol effect, e.g., a sober-up pill that rapidly oxidizes alcohol in the body.
75. Change opinions of peers. This might be especially effective in high school and early college age groups. The drinker would now be a member of an out-group, not an in-group.
76. Change the self-image of the drinking driver. For example, show sound color films or photographs of himself under the influence of alcohol to him rather than to the lawyers or jury for legal purposes.

77. Change the self-image of the driver by having drinking drivers referred to a psychiatrist, psychologist, or "mental health counselor", as was done by Barnack and Payne (1961).
78. Use publicity in regard to those convicted of driving while intoxicated.
79. Put person on an alcoholic ward over a weekend after first DWI conviction so he sees and talks with late stage alcoholics.
80. Teach young drivers how to stay awake while driving at night: Shoes off, window open, sing, loud radio, short nap at roadside, etc.
81. Bring "peer pressure" to bear on the buyer of alcohol for underage drinkers.
82. Use telephone "hot lines": For drinker assistance, 24-hour information and referral, or for direct access to previous driver records.
83. Reduce time and "red tape" requirements for arresting officers.
84. Use mobile breath testing vehicles that move directly to scene of arrest or accident.
85. Organize and utilize local volunteers for public education efforts.
86. Make convicted DWI offenders who are at fault for an accident, responsible for all associated financial losses, up to a level of 50% of their total net worth.
87. Have judges and police officers drink, in a protected environment, until their BAC reaches 0.10%.
88. Form a union of nondrinking drivers to lobby for legislation, reduced insurance rates, etc. (Andreasson).
89. Publicize the place at which the driver or pedestrian had been drinking as part of the accident report in alcohol-related accidents (especially fatalities).
90. Use alcohol-related trigger films for groups discussions.
91. Enhance social tolerance for alcohol abstinence.
92. Encourage employers to use the threat of job loss as a lever to move problem drinkers to obtain treatment.
93. Focus on early detection of problem drinking (alcoholism, like cancer, can be controlled if detected early enough).

94. Improve host behavior, e.g., serve fewer drinks, serve less potent drinks, serve food, provide sober drivers for heavy drinkers.
95. Publicize widely the states of alcoholism and, especially, the symptoms associated with early stages.
96. Encourage public to drive less during high risk hours for alcohol-related accidents.
97. Teach alcoholic drinkers (gulping pattern, several drinks in short time period) to become social drinkers (sipping pattern), fewer drinks over same period of time (Mills, 1971).
98. Have police officers randomly sample BAC's in bars and issue warning to those with BAC's at or above 0.10% that they cannot drive.
99. Double the taxes on alcohol and devote increased revenue to countermeasures against alcohol-related traffic accidents.
100. Encourage the idea that even small amounts of alcohol may be deleterious to health.
101. Establish a new bar tax to which exemptions are granted on the basis of proximity of the customer's residence to the bar (P. Hurst, personal communication).
102. Make technical literature and samples of previous alcohol-oriented public information campaigns available free to persons who request it (Highway Safety Research Institute, Public Communications Group, 1972).
103. Standardize the closing time of all drinking establishments and increase substantially the enforcement shortly before and after that time. (See Raymond, 1969.)
104. Promote the adoption of pre-arrest breath testing similar to that used in Great Britain.
105. Develop, validate, and apply paper and pencil tests to identify potentially dangerous drinker drivers (Selzer & Chapman, 1971; Mortimer & Lower, 1971).
106. Identify community officials likely to be working with abusive drinkers and enlist their support in the planning and execution phases.
107. Reduce the frequency of "plea-downs", informal arrangements to plead guilty to a lesser offense, e.g., reckless driving rather than DWI.

APPENDIX THREE

APPENDIX III

TABLE IV—CUMULATIVE BENEFITS AND COSTS OF COUNTERMEASURES RANKED BY DECREASING COST-EFFECTIVENESS IN PRESENT VALUE DOLLARS PER TOTAL FATALITIES FORESTALLED—10-YEAR TOTAL (BENEFIT REDUCED BY EFFECTS OF EACH COUNTERMEASURE PREVIOUSLY EMPLOYED)*

Countermeasure	Fatalities Forestalled (A)	Cost (\$millions) (B)	Dollars per Fatality Forestalled (\$millions) (C)	Cumulative Fatalities Forestalled (D)	Cumulative Public Costs (\$millions) (E)
1. Mandatory safety belt usage	89,000	45.0	506	89,000	45.0
2. Nationwide 55-miles-per-hour speed limit	25,800	676.0	26,200	115,000	721.0
3. Highway construction and maintenance practices	326	9.2	28,100	115,000	730.0
4. Upgrade bicycle and pedestrian safety curriculum offerings	400	13.2	33,100	116,000	743.0
5. Driver improvement schools	1,550	53.0	34,100	117,000	796.0
6. Regulatory and warning signs	2,650	125.0	47,200	120,000	921.0
7. Guardrail	2,220	108.0	48,700	122,000	1,030.0
8. Pedestrian safety information and education	343	18.0	52,500	122,000	1,050.0
9. Skid resistance	2,580	158.0	59,000	125,000	1,200.0
10. Bridge rails and parapets	1,050	69.8	66,200	126,000	1,270.0
11. Wrong-way entry avoidance techniques	577	38.5	66,700	127,000	1,310.0
12. Motorcycle rider safety helmets	804	61.2	76,200	127,000	1,370.0
13. Driver improvement schools for young offenders	432	36.3	84,100	128,000	1,410.0
14. Motorcycle lights-on practice	42	5.2	125,000	128,000	1,420.0
15. Impact-absorbing roadside safety devices	4,670	735.0	157,000	133,000	2,150.0
16. Breakaway sign and lighting supports	2,200	379.0	172,000	135,000	2,530.0
17. Selective traffic enforcement	5,740	1,010.0	176,000	141,000	3,540.0
18. Combined alcohol safety action countermeasures	8,830	2,130.0	242,000	149,000	5,670.0
19. Citizen assistance of crash victims	2,790	784.0	281,000	152,000	6,460.0
20. Pedestrian and bicycle visibility enhancement	1,060	332.0	313,000	153,000	6,790.0
21. Median barriers	343	121.0	352,000	154,000	6,910.0
22. Warning letters to problem drivers	142	50.5	356,000	154,000	6,960.0
23. Tire and parking system safety critical inspection—selective	3,050	1,150.0	377,000	157,000	8,110.0
24. Clear roadside recovery area	336	151.0	450,000	157,000	8,260.0
25. Upgrade education and training for beginning drivers	2,240	1,170.0	523,000	159,000	9,430.0
26. Intersection sight distance	339	196.0	580,000	160,000	9,630.0
27. Combined emergency medical countermeasures	5,180	4,300.0	830,000	165,000	13,900.0
28. Upgrade traffic signals and systems	2,410	2,080.0	861,000	167,000	16,000.0
29. Roadway lighting	478	709.0	1,480,000	168,000	16,700.0
30. Traffic channelization	486	1,080.0	2,220,000	168,000	17,800.0
31. Periodic motor vehicle inspection—current practice	1,190	3,890.0	3,280,000	169,000	21,700.0
32. Pavement markings and delineators	145	639.0	4,410,000	170,000	22,300.0
33. Railroad-highway grade crossing protection (automatic gates excluded)	207	974.0	4,710,000	170,000	23,300.0
34. Selective access control for safety	803	3,780.0	4,710,000	171,000	27,100.0
35. Bridge widening	811	4,600.0	5,680,000	171,000	31,700.0
36. Paved or stabilized shoulders	571	5,380.0	9,410,000	172,000	37,100.0
37. Roadway alignment and gradient	374	4,530.0	12,100,000	172,000	41,600.0

* All figures have been rounded to three significant digits after internal computations were completed. All figures are subject to the caveats concerning precision of the data.